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## Start-Up Financing in the Digital Age – A Systematic Review and Comparison of New Forms of Financing

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# Start-up Financing in the Digital Age – A Systematic Review and Comparison of New Forms of Financing

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## ABSTRACT

Start-ups are seen as the leading force in dynamically growing economies. Limited financing opportunities often prevent entrepreneurs from realizing their innovative business ideas or taking growth opportunities. However, in the context of the technological revolution, a fundamental change in the entrepreneurial finance landscape is observed. Innovative, digital financial instruments such as Business Angel Networks, Crowdfunding, or Initial Coin Offerings provide young companies with attractive financing opportunities. Although a large number of studies focus on start-up financing in the digital age, the literature is still fragmented. By providing a systemic literature review of 85 high-quality peer-reviewed journal articles published between 1990 and 2019, we address the following purposes: First, we outline a holistic picture on the financing spectrum of start-ups in the digital age. Therefore, we classify the articles into two categories as traditional or novel financing instruments. Subsequently, we associate the different financing instruments into the various growth stages of start-ups and define them as equity or debt. Second, we evaluate the suitability of novel financing instruments based on the trade-off and pecking order theory. Third, we investigate whether new forms of financing are substitutes or complements to traditional financing forms. Furthermore, ideas for further research are suggested.

**Keywords** Entrepreneurial finance; Financing instruments; Start up financing; early stage financing; SME financing; sustainable finance; systematic literature review

**JEL classifications** L26, L31, G21, G23, G24, G32

## I. Introduction

Innovative, young start-ups are essential for employment, prosperity and growth and are, therefore, an important component of dynamic economies (Berger & Udell 1998; Denis 2004; Shane & Cable 2002). Not least because of their market novelty and the associated low reputation and small size, such companies are among the most opaque in the entire economic system in terms of information (Cassar 2004). In the early phase of a company's existence, a lack of profitability, as well as a lack of sufficient security, valid balance sheet figures, or proof of success, are often added (Bernstein et al. 2017; Jones & Jayawarna 2010). This can result in information asymmetries and moral hazard problems between start-ups and investors (Lee et al. 2015; Nofsinger & Wang 2011). As a consequence of this market imperfection, limited capital availability may result for companies seeking capital (Berger & Udell 2006; Beck & Demirguc-Kunt 2006; Colombo & Grilli 2007). The capital supply side suffered a setback in the wake of the financial crisis that began in 2007 and the ensuing regulatory crisis (Block et al. 2018). There is no doubt that an opaque or weak regulation leads to a lower quality of e.g. reports to be prepared and can thus make it more difficult to obtain VC capital or bank loans (Bellavitis et al. 2017). Taking this into account, appropriate regulation can promote the creation and preservation of capital by reducing market entry costs and ensuring contractual security (Block et al. 2018).<sup>1</sup> However, mis-regulation or over-regulation may affect the structure of markets and, in extreme cases, lead to the exclusion of certain market participants (Denis 2004; Mitter & Kraus 2011; Wu et al. 2016). In this context, the negative feedback effects of the stronger regulation of credit institutions introduced by e.g. Basel II,5 and Basel III should also be emphasized (Ben Naceur et al., 2018; Deloof & Vanacker 2018). Although market-based financial systems tend to reveal a faster recovery from exogenous shocks than bank-based counterparts, this alone does not indicate a general superiority of one form over the other (Allard & Blavy 2011). In times of the financial crisis, aggregate US venture capital investment fell by almost 30% (Dahiya & Ray 2012; Tenca et al. 2018). In fact, the growth of innovative industries, the creation of new firms, and a good long-term economic performance, do not depend on the different financial structure of either a bank-based or a market-based financial system. Instead, it is the level of general economic development as well as the efficiency of the legal system that are proving to be decisive factors (Beck & Levine 2002; Levine 2002). However, this also illustrates that it has become much more difficult for young

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1 For the financing form of crowdfunding, the governments in Europe and America first had to create the legal framework (Hornuf & Schwienbacher 2018). Another example is the creation of the governmental venture capital funds in Europe. Other policy measures include the provision of guarantees and subsidies (Cumming & Groh 2018; Rostamkalaei & Freel 2016).

companies, and in particular innovative start-ups, to raise capital again after the financial crisis, regardless of the respective financial system (Block et al. 2018; Lee et al. 2015).

Besides, the simplified communication possibilities and worldwide networking created by technological progress are leading to a more diverse capital supply side. Sometimes limiting spatial and temporal obstacles are pushed into the background (Nambisan 2017). For example, only this has made it possible for business angels to join together to form globally operating networks. Forms of financing such as crowdfunding are also based on the existence of the Internet and new communication channels such as social media. The implications of technological factors and the disruptive potential become apparent in the case of initial coin offerings (ICOs) that are based on a revolutionary and innovative technology such as the Distributed Ledger Technology (DLT) (Fisch 2019). On the demand side, too, the innovative financing options open up possibilities beyond the procurement of capital (Block et al. 2018). The desire to be part of technological progress and to use it to one's own advantage manifests itself in the efforts of companies. For example, founders use digital swarm financing to test their products before they are launched on the market. Such early customer interaction can be a great advantage, especially in highly competitive markets with high digitalization (Dushnitsky & Shapira 2010). Increasing ecological awareness is also leading to a change on the demand side. In particular, companies are predestined to break new ground and take on a pioneering role. Such start-ups often need external capital in order to successfully build their business. However, the sustainable approach, with its holistic approach and the associated lower financial return, places entirely new demands on investors. As a result, some existing forms of financing have recently developed into sub-forms in which investors respond to the new requirements placed on them.

It is well known that the activities of established financial intermediaries such as banks sometimes aim to reduce information asymmetries, but they are costly and cause agency problems such as moral hazard (Block et al. 2018). Digital forms of financing, on the other hand, lead to disintermediation and reduce the costs mentioned above. However, the discontinuation of these activities also means that information asymmetries are much more pronounced in such forms of digital financing. Also, there is a lack of legal certainty, which still exists, for example, in the entire field of ICOs (Fisch 2019). The inevitable question is to what extent there can be a fundamental change in the financing spectrum of young companies. Are the proven financing instruments facing a changing of the guard?

Start-up financing is undisputedly a subject that has been dealt with extensively in the literature. Nevertheless, there is currently a lack of a holistic overview, which rep-

resents both traditional and novel financing instruments for young companies. The following systematic literature analysis should contribute to closing the identified gap. In addition to a classification of the respective form of financing along the life cycle of a company and the type of capital provided, critical comparison and evaluation of suitability are carried out. The latter is done with the help of the trade-off and pecking order theory. Building on this, the question will be answered to what extent digital forms of financing should be regarded as a substitute or rather as a complement to proven financing instruments. Finally, potential research questions that could be the subject of future studies are outlined.

## II. Methodology

A systematic literature analysis makes it necessary to adhere to a structured, transparent, and reproducible process. The present systematic literature analysis is primarily based on the guidelines of Tranfield et al. (2003). Additionally, already published "best practices" of other authors have been incorporated into the procedure and the work process (Bouncken et al. 2015; Calabrò et al. 2018; Mochkabadi & Volkmann 2018). To ensure a structured and reproducible process, the analysis is divided into three basic steps:

1. Planning the analysis
2. Carrying out the literature search
3. Reporting of the results

When *planning the analysis*, the focus is on developing a suitable protocol for documenting the work steps. In order to identify those articles that can contribute in a reliable way to answering the questions outlined at the beginning, the admission and exclusion criteria to be taken from Table 1 were defined before the search was carried out (Tranfield et al. 2003). Only those literature contributions which met all criteria have been included in the literature analysis.

**Table 1: Admission - and exclusion criteria for the analysis of the literature**

Admission - and exclusion criteria	
Language	<ul style="list-style-type: none"> <li>• English</li> </ul>
Form of publication	<ul style="list-style-type: none"> <li>• Exclusively published articles from scientific journals that are peer-reviewed and have an ABS-Journal Ranking 2018 grade of at least one or are evaluated with a 2-year journal impact factor 2018 Journal Citation Report of at least 1.3.</li> <li>• Publication period 1990-2019</li> </ul>
Content criteria	<ul style="list-style-type: none"> <li>• Focus on the description of the various forms of financing and their determinants and classification of the role they play in the context of start-up financing.</li> <li>• Articles, which show the factors for the development of new forms of financing and allow for an evaluation of the relevance of the new forms.</li> </ul>
Study design	<ul style="list-style-type: none"> <li>• Empirical studies</li> <li>• Theoretical contributions</li> </ul>

The actual *literature search* was carried out using a keyword search. The basis for this was the definition of topic-relevant keywords, which are contained either in the title, summary, or keywords of the articles. Due to the thematic nature of the work and the focus on new forms of financing, the following string resulted: "entrepreneur\* financ\* new OR entrepreneur\* financ\* digital OR start-up financ\* new OR start-up financ\* digital OR new ventur\* financ\* OR digital ventur\* financ\* OR SME financ\* new OR SME financ\* digital OR sustainable ventur\* financ\* OR sustainable entrepreneur\* financ\* OR sustainable start-up financ\*".

**Table 2: Results of initial keyword search and search procedure**

Filter	Description	BASE	EconLit (EBSCO- host)	Science Direct	Wiley Online Library	Springer Link	Scopus	Total
Step 1	Article after entering the tags	239	3.396	735	2.451	1.170	4.177	12.168
Step 2	Article after reading the title and elimination of the irrelevant items							157
Step 3	Article after reading the summary and elimination of the irrelevant items							99
Step 3	Article after reading the entire article and elimination of the irrelevant items							59
Step 4	Specific search and citation tracking							26
	<b>Final sample</b>							<b>85</b>

This was applied in six databases (see Table 2). The large number of hits can be explained on the one hand by the large number of keywords and on the other hand, by the large number of duplicates that can be recorded during initial search runs. In addition to the initial hits, the number of remaining articles can be taken from the table after individual steps to check the relevance of the content. Exclusion criteria are the previously defined criteria of a substantive nature. As already described, adjustments can be made in the course of the systematic literature analysis. Employing the specific search and citation tracking carried out in step 4, 26 further research contributions could be identified. The final sample of 85 articles was analyzed thematically at the end of the search in order to categorize them. This has resulted in two categories of articles with the following main content:

1. Traditional forms of financing
2. Novel forms of financing

Traditional forms of financing are the forms of financing for start-ups that have been known and studied in the literature for some time. The contribution by Berger and Udell (1998), published as early as 1998, can be seen as leading articles here, in which all forms assigned to the category of traditional forms of financing are mentioned. On the other hand, novel forms of financing are defined as those whose relevance as a possible form of financing for young companies has received attention in the last ten years. The article by Block et al. (2017), which names "new players" in the field of start-up financing, should be mentioned here. The division of the categories into traditional and novel forms of financing is reinforced by the aggregated number of publications by category (see Figure 4). Publications on the forms of financing categorized in the category "novel forms of financing" have risen sharply in the years since 2013. Whereas traditional forms of financing show a steady treatment in science. It should also be added that forms of financing less relevant but theoretically feasible for start-ups, such as the SME bond or the micro-credits known for small businesses, predominantly in developing countries, were not taken into account.

### III. Results of the literature analysis

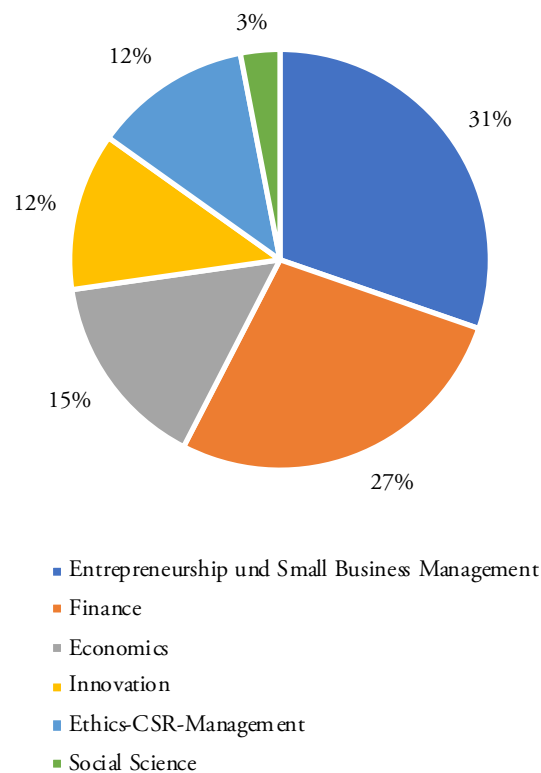
In the following section, the *reporting of the results* takes place. First, the results of the descriptive analysis of the final collection of 85 articles will be presented in order to outline the results of the thematic analysis. However, the descriptive analysis is limited to information on the distribution of publications by journal and topic, on the methodology of the studies, and on their geographical scope (for further detailed evaluation, see Annexes I and II).



### A. Characterization of the literature

The 85 journal articles identified as relevant were published in a total of 38 different journals (see Annex I, Table 9). The most prominent journals are Small Business Economics, Journal of Corporate Finance, and Journal of Business Venturing. Almost 30% of the selected articles were published in these three journals. A large proportion of the articles, 58% of which come from journals that can be expected to be assigned to the areas of entrepreneurship, small business management, and finance (see Figure 1).

**Figure 1:** Distribution of journals depending on themes due to the ABS Journal Guide



With regard to the geographical coverage of all empirical studies, it can be noted that the majority of these studies fall into two regions: Europe and North America [(see Table 3 and Table 4; Table 3 and Table 4 are own representations based on (Mochkabadi & Volkmann 2018))].

**Table 3: Geographical coverage in general**

Regions	Total (%)
Europe	45,45%
North America	31,82%
Asia	7,58%
South America	1,52%
Australia	1,52%
Multi Continental	12,12%

**Table 4: Geographical coverage in Europe**

Countries	Total (%)
Multinational	20,00%
United Kingdom	40,00%
Italy	10,00%
Belgium	6,67%
Germany	6,67%
France	6,67%
Others	10,00%

The importance of these two regions is demonstrated by the fact that all multicontinental studies also include at least one country from Europe and North America. Within Europe, a large proportion of studies use data from the United Kingdom, followed by Italy and Belgium. 95.24% of data from North America came from the United States, and only one in 21 studies used a data set from Canada. Besides, 51.52% of the studies can be located in the Anglo-Saxon region.

**Table 5: Methodology applied**

Typology	Total (%)
<i>General</i>	
Quantitative	60,00%
Qualitative	20,00%
Theoretically	15,29%
Mixed	4,71%
<i>Data collection</i>	
<u>Quantitative</u>	
Databases	48,15%
Survey	25,93%
Case studies	20,37%
Experiments	5,56%
<u>Qualitative</u>	
Interviews	50,00%
Literature review	33,33%
Case studies	16,67%
Survey	5,56%

**Table 6: Analysis of quantitative studies**

Quantitative studies	Total (%)
<i>Methodology</i>	
Regressions	87,04%
Mean differences	5,56%
Descriptive statistics	3,70%
Structural equations	1,85%
Conjoint analysis	1,85%
<i>Regression method</i>	
Logit	24,07%
OLS	20,37%
Probit	18,52%
Tobit	12,96%
Linear	7,41%
Other (WLS, Hierarchical, Binomial, Heckman, Naive, Panel, DDD, Mediation, Progress, etc.)	22,22%
Unknown	3,70%

Concerning the typology of the studies, it should first be said that for a systematic literature analysis due to their positivistic origin, quantitative studies are very well suited (Tranfield et al. 2003). Table 5 shows that this systematic literature analysis is also based on the results of quantitative studies. Together with studies of mixed typology, each of which also uses quantitative methods, 64.71% of all studies are based on quantitative research paradigms. In terms of data collection, these quantitative studies rely, for the most part, on databases or surveys. The sample size varies from 26 to 77,654 data sets (see Table 7, Table 8 and Annex I, Table 10). At 87.04%, an overwhelming majority runs regression. A large number of different regression procedures are used for this purpose. It should be noted, however, that many studies use more than one procedure in the *regression procedure* section of Table 6. This is the reason why there are double counts. A total of 17 different regression methods were used in quantitative studies. Logit, OLS, Tobit and Probit regressions are the most common regression methods. Moreover, 20% of the studies apply a qualitative design. With 50%, a considerable part of the qualitative studies falls back on an interview-based approach. In addition to these, 33.33% of qualitative studies are literature analyses. Of these six literature analyses, however, only one can be classified as a systematic literature analysis. Qualitative studies vary in literature analysis between 25 and 413 contributions, respectively 13 and 54 participants in the interview, case, or survey-based studies (see Table 7, Table 8 and Annex I, Table 10).

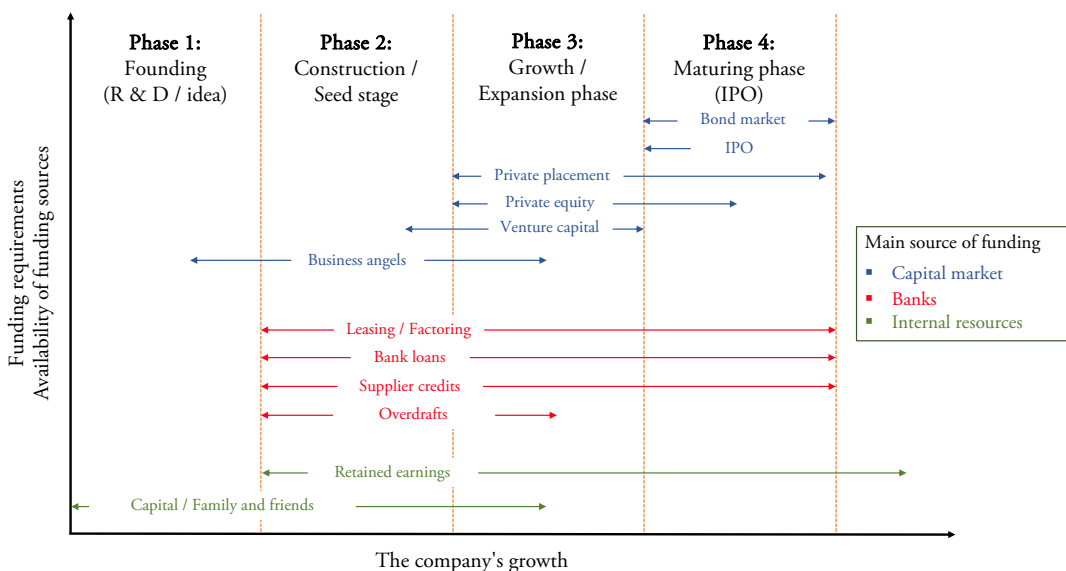
### *B. Content analysis*

The results of the thematic/content analysis are presented below. This takes place in superordinate categories, structured according to traditional and novel forms of financing. In the course of the allocation of contributions to the respective category, the identified research gap became clear once again. A total of only 6 articles remotely provide a holistic overview of the diverse traditional and novel forms of financing for start-ups and SMEs (for a detailed presentation see Annex I, Table 10). Within the categories, the articles are classified according to their main content, in relation to the forms of financing. *Italic subtitles* identify these subcategories in the literature tables.

### C. Traditional forms of financing

A total of 37 articles have been assigned to the category of traditional forms of financing. These have been divided into the following subcategories according to the topic covered: General, Bootstrapping, Equity from founder and closer environment, Business angel, Business angel and venture capital, Venture capital, Credit financing and private venture capital, as well as Credit financing. In the following an allocation of the mentioned forms into the life cycle of a start-up is made first.

**Figure 2:** Allocation of traditional forms of financing into the life cycle of a start-up



**Table 7: Traditional forms of financing**

Author (s)	Year	Typology	Database	Dependent variable	Independent variable	Form of capital	
General							
Atherthon	(2009)	Qualitative; interview-based study	26 founders	n / A	n / A	x	x
Berger and Udell	(1998)	Quantitatively empirical; descriptive	15,714 small businesses	n / A	n / A	x	x
Cassar	(2004)	Quantitative; regression analysis	292 new companies	The location and amount of funding use	Company size; asset structure; legal organization; growth opportunities; owner features	x	x
Conti et al.	(2013)	Mixed methodology: regression analysis; theoretical model	787 high-tech start-ups	Changing the number of patents between conveying rounds	Number of new investors between rounds of funding; raising amount	x	x
Cosh et al.	(2009)	Quantitative; regression analysis	2,520 start-ups	External financing	Corporate financial characteristics; company age - and profile; competitor / industry	x	x
De Bettignies	(2008)	Theoretically	n / A	n / A	n / A	x	x
Ho and Wong	(2007)	Quantitative; regression analysis	28 countries	National entrepreneurial readiness	Availability of different forms of financing; regulatory operating costs	x	x
Mitter and Kraus	(2011)	Theoretically	n / A	n / A	n / A	x	x
Nofsinger and Wang	(2011)	Quantitative; regression analysis	1,869 early-stage start-ups	Debt ratio	New product; new technology; start-up experience	x	x
Paul et al.	(2007)	Qualitative; interview-based study	20 Scottish founders with successful angel investment	n / A	n / A	x	x

Table 7: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital	
					EQ	Debt
Robb and Robinson (2014)	Quantitative; regression analysis	3,972 new company	Debt ratio	Elasticity of the house supply; state bankruptcy exemption; owner characteristics; industry affiliation; creditworthiness	x	x
Staniewski et al. (2016)	Quantitative; Mean differences	345 founders	Funding source	Founding motive	x	x
<i>Bootstrapping</i>						
Jones and Jawařna (2010)	Mixed methodology: structural equation and theoretical model	211 founders with scholarships of the NES program	Performance of the new company	Social networks; bootstrapping techniques	x	x
Lam (2009)	Qualitative; interview-based study	65 companies and respondents	n / A	n / A	x	x
<i>Equity from founder and closer environment</i>						
Au et al. (2016)	Quantitative; Mean differences	128 informed students	Looking for financial help with family and outsiders	Venture risk; relationship close	x	x
Elston and Audretsch (2011)	Quantitative; regression analysis	182 participants in a conference	Establishment decision	Sources of funding for start-up phase; sources of financing for growth phase	x	x
Wu et al. (2016)	Quantitative; regression analysis	3,235 founders	Product innovation performance	Level of informal debt; access to formal financing; level of institutional development		x
<i>Business angel</i>						
Bonini et al. (2019)	Quantitative; regression analysis	111 BA-funded enterprises	Five-step ordinal variables Experience Index	Co-investors; BAN membership; equity infusion pattern; active engagement; monitoring software	x	
<i>Business angel and venture capital</i>						
Bernstein et al. (2017)	Quantitative; regression analysis	4,494 potential BA - and VC investors	Investor interest	Founding team; investors; transaction information		x

Table 7: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital
					EQ Debr
Kim and Wagman (2016)	Theoretically	n / A	n / A	n / A	x
Razinger et al. (2018)	Quantitative; regression analysis	4,953 digital startups	Investment milestones	Higher technical/business education; general higher education	x
Shane and Cable (2002)	Mixed Methodology: regression analysis; interview-based study	50 high-tech startups	Investment made	Social relationships; reputation	x
<i>Venture capital</i>					
Bertoni et al. (2011)	Quantitative; regression analysis	538 new technology-based companies	Company size	Company and owner characteristics; # of patents	x
Bertoni et al. (2015)	Quantitative; Structural equation model	361 companies in the high-tech sector	Capital investment company	Capital investment of the company; financial measures	x
Cumming (2005)	Empirically Quantitative; regression analysis	3,083 financing transactions	Forms of financing	Company characteristics; corporate funds; investment; financing round; industry characteristics	x
Dahiya and Ray (2012)	Quantitative; regression analysis	40,685 VC financing rounds	Project results	Total invested resources; market - and technology uncertainty	x
Inderst and Müller (2009)	Theoretically	n / A	n / A	n / A	x
Wilson et al. (2018)	Quantitative; regression analysis	2,487 investments by venture capital funds	Value of venture capital deals	Intangible assets; securities; customer base; financial performance; characteristics of human capital	x
<i>Credit financing and private venture capital</i>					
Winton and Yerramilli (2008)	Theoretically	n / A	n / A	n / A	x

Table 7: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital	
					EQ	Debt
<i>Credit financing</i>						
Cole and Sorklyk (2018)	Quantitative; regression analysis	4,928 new company	Any kind of debt	Company characteristics; owner characteristics; other capital sources; industry classifications		x
Colombo and Grilli (2007)	Quantitative; regression analysis	386 new technology-based companies	Debt ratio; amount of private capital and bank lending	Characteristics of human resources; industry characteristics; business uncertainty; infrastructure; # of equity provider; real interest rate; pass rate		x
Dai et al. (2017)	Quantitative; regression analysis	4,000 Small Business	Credit inquiries	Company characteristics		x
Deloof and Vanacker (2018)	Quantitative; regression analysis	14,846 start-ups	Financial - and real effects	Company and industry characteristics; characteristics of human resources		x
Huyghebaert et al. (2007)	Quantitative; regression analysis	325 start-ups	Debt mix	Credit risk; Private benefits of control; liquidation value; growth opportunities; profitability		x
Lee et al. (2015)	Quantitative; regression analysis	10,000 small businesses	Financing request and their success	Company characteristics		x
Rajan and Peterson (1994)	Quantitative; regression analysis	3404 Small Business	Interest rate of the last loan; late repayment	Company, - credit, -region and industry characteristics; macroeconomic interest variables; relationship features; investment opportunities; cash flow		x
Rostamkalaei and Freel (2016)	Quantitative; regression analysis	247 small businesses that credit took advantage	Pay rate	Growth story; growth ambitions; growth strategies		x



Studies from articles in the *general* subcategory examine the choice of any traditional form of financing and can, therefore, be used to describe several forms of financing. *Bootstrapping*, which combines various forms of start-up financing, basically describes two different strategies. On the one hand, the procurement of capital outside of long-term external and equity investors is in the foreground, on the other hand, Bootstrapping has the goal of using existing resources sparingly and increasing them as far as possible without the need for financing (Jones & Jayawarna 2010; Lam 2009). At bootstrapping, various internal and/or short-term external and equity sources can be used to finance the company. Consequently, bootstrapping occupies a unique position concerning other traditional forms of financing, which take the form of pure debt financing or equity financing. The *capital of the founder and his close environment*, family and friends, is one of the most important internal sources for bootstrapping. In addition to the capital saved before the foundation, founders finance their project with the help of a private credit card, by cross subsidizing a paid second job or with the help of the full-time job of their spouse (Jones & Jayawarna 2010; Lam 2009). Friends and the extended family also act as sources of financing. These informal investors are often prevalent in the initial start-up phase and provide capital mainly in the form of loans. Despite the advantage that with informal investors information asymmetries are reduced through the personal relationship, they do not play a major role in the overall context of financial instruments in terms of investment volume (Nofsinger & Wang 2011; Robb & Robinson 2014). Nevertheless, bootstrapping has a positive impact on the company's performance, depending on the strength of the relationships in the founder's social network and the appropriate use of this network (Jones & Jayawarna 2010). A medium level of informal debt also has a positive impact on product innovation (Wu et al. 2016). An external source of financing for bootstrapping is *leasing or hire purchase* (Bellavitis et al. 2017; Jones & Jayawarna 2010). The special feature here is that the financing is done in connection with a provided product. Of all the traditional forms of financing, the lowest rejection rate of 5% is worth highlighting (Cosh et al. 2009).

Once the initial start-up phase of a start-up is over, *business angels (BA)* often appear as the first external equity providers in the seed phase. Business angels are wealthy individuals who invest their private assets in young start-ups with great growth potential. This is done by providing venture capital in exchange for company shares. Often having been active as founders themselves or as experts in a specific industry, business angels can contribute additional expertise and an excellent network in addition to their capital and thus support the founders comprehensively (Cumming & Groh 2018; Tenca et al. 2018). Companies that receive their first BA financing are, on average, 10.5 months old, and only just under 30% can already show sales. The investment sum can vary from US\$ 10,000 to US\$ 2,000,000 but is relatively small compared to institutional investors

(Cumming & Groh 2018; Denis 2004). BAs focus primarily on regional companies (Denis 2004; Mitter & Kraus 2011). Experienced and successful investors, in addition to a good business plan and good business opportunities, increasingly pay attention to information regarding the founding team when making their investment decision (Bernstein et al. 2017; Tenca et al. 2018). A direct relationship between BA and the founders increases the probability of investment. If a founder has a corresponding reputation, this also increases the probability of investment (Shane & Cable 2002). Once a start-up has been able to win a BA as an investor, this increases the attractiveness of the start-up for other investors as well (Denis 2004; Mitter & Kraus 2011). This signal effect is one of the most important added values offered by a BA, along with the contribution of one's own experience and active participation in the further development of the company (Bonini et al. 2019). If a start-up even manages to attract several co-operating BA investors, this syndicate of co-investors, due to a wider range of non-monetary contributions, demonstrably leads to increased business performance and a higher survival rate within the next three years after the investment. (Bonini et al. 2019). However, a 1993 study using NSSBF data shows that only about 3.59% of start-ups are financed by business angels, which shows the limited access to this form of financing (Berger & Udell 1998).

The financing of BAs is often followed by another form of external equity financing, namely *venture capital (VC)*. Unlike business angels, VCs operate in the form of public or private investment companies that provide venture capital to start-ups. The invested sums usually comprise amounts in the millions (Kim & Wagman 2016; Robb & Robinson 2014). The primary investment targets are innovative companies with high growth potential, but which often entail a high risk (Cosh et al. 2009). From the founder's point of view, the same applies: venture capital is attractive for start-ups with great growth ambitions and the associated high strategic uncertainty, low prospects of success, but in the case of success, strongly positive cash flows (Winton & Yerramilli 2008; de Bettignies 2008). Technology-based companies can be cited as a prime example and preferred target group (Ho & Wong 2007; Denis 2004). In addition to venture capital, VCs as active investors bring their expertise and access to networks to the respective start-up as value-adding services. They also perform monitoring tasks to reduce existing information asymmetries. This active investment approach, combined with the risk taken, makes VC funds demand a higher return, which in turn leads to high capital costs compared to otherwise financed start-ups (Denis 2004; Winton & Yerramilli 2008). Additionally, VC funds often require a substantial ownership share (Kim & Wagman 2016). For a long time, it was assumed that convertible preference shares were the best choice. However, it can be seen that VC funds participate in invested companies through very different forms (Cumming 2005). Due to the requirement profile and the high capital

costs for start-ups, only a very small proportion of start-ups have access to venture capital, similar to business angels (Berger & Udell 1998; Cosh et al. 2009; Ho & Wong 2007). In a study using data from US start-ups between 2004 and 2007, only 27 out of 3,972 companies received funding from VC funds (Robb & Robinson 2014). An observed rejection rate of 46% also shows how meticulous the selection process is (Cosh et al. 2009). To attract VC, technology-based start-ups use patent applications as a signal of their quality (Conti et al. 2013). Start-ups that receive capital from VC funds are usually financed in several rounds. This step-by-step investment presents itself as efficient from the point of view of resource allocation (Dahiya & Ray 2012; Denis 2004). In addition, reinvestment in a later round, regardless of the sum invested, leads to a positive signal effect on other investors, such as lenders but also other VC funds (Bertoni et al. 2011). Moreover, VC investments in companies in highly competitive industries can have a positive impact on the speed of growth (Inderst & Mueller 2009). In the case of new technology-based companies, for example, they have a considerable positive impact on the growth of employment and turnover (Bertoni et al. 2011). However, in the case of knowledge-based start-ups, despite the positive effects on growth and the positive signal effect of patents and VC investments already received in earlier phases, it is evident that these companies face an equity financing gap in a later phase (Wilson et al. 2018).

Once a company has established itself on the market and has become successful, the *Initial public offering (IPO) or acquisition* can be considered as a further form of financing. In addition to the founder, this step is particularly important for equity investors such as venture capitalists, as they can terminate their investment and repay returns to the fund investors through an IPO or acquisition (Denis 2004; Drover et al. 2017; Cumming & Groh 2018). In IPO presents itself as the more attractive variant of an exit (Berger & Udell 1998). It is advantageous for the founder to have been previously financed by a VC fund when going public. VC-supported companies, for example, have a higher share price when placed for the first time, and also outperform unsupported companies in the long term. Furthermore, VC funds help to choose the right time. In principle, the more renowned the VC fund, the more advantageous it is for a start-up company to go public (Berger & Udell 1998; Drover et al. 2017). VC funds build up their reputation through successful IPOs that have already been completed (Cumming & Groh 2018). In principle, the university education of the founders of digital start-ups that fit into the target group of innovative and growth-oriented portfolio companies has a significant influence on all three equity financing options mentioned above. Furthermore, it can be seen that with higher education acquired by members of the founding team, the probability of obtaining external equity and a successful exit, increases significantly with each higher degree (Ratzinger et al. 2018).

Next to the forms of financing already presented, start-ups have the option of financing their projects with short-term borrowed capital. One form of short-term debt financing is the so-called *factoring*, which is based on the assignment of receivables. Especially companies with high growth targets and low-profit levels tend to use factoring. A study carried out between 1996 and 1997 found that with 151 of the 2520 firms, only a small number of around 6% were involved in factoring. However, it should be noted that the average age of the companies in this sample was 2,661 years (Cosh et al. 2009). Thus, factoring for young start-ups, which often have no sales at all, will probably represent a subordinate financing alternative than the figures mentioned.

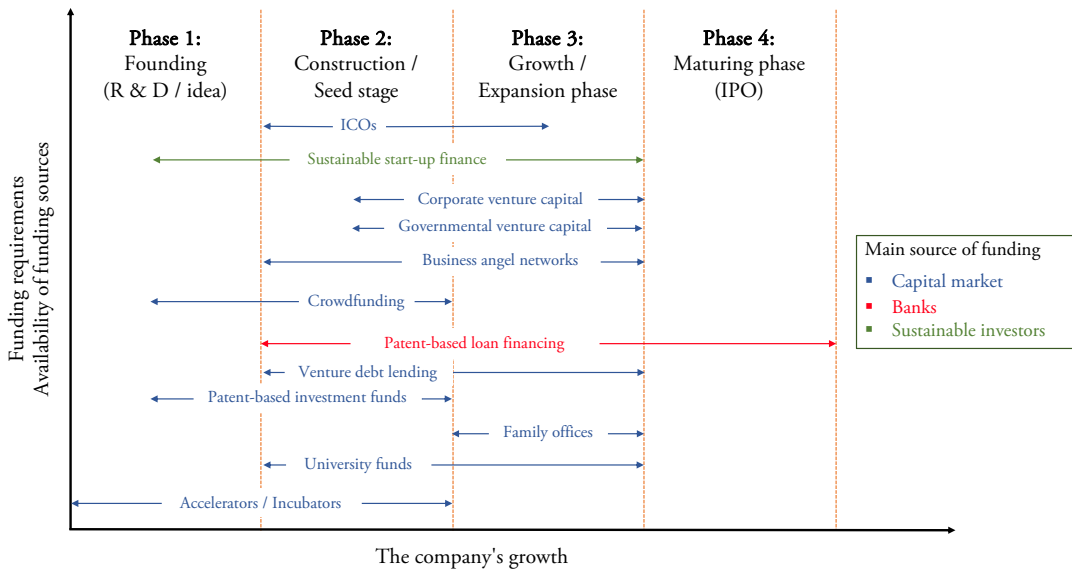
In addition to factoring, start-ups are also available as a further source of short-term borrowed capital in the form of *customer or supplier credits*. In the case of a customer loan, the company already receives payments for services not yet rendered. In the case of a supplier credit, purchased goods and services shall not be paid immediately upon delivery (Mitter & Kraus 2011). In contrast to factoring, these forms of financing are, therefore, not significantly dependent on the existence of sales. Despite the relatively high capital costs of financing through supplier credits, these play an important role in financing start-ups (Robb & Robinson 2014). Various studies show that between 15.78% and 21.74% of start-ups' assets are financed by supplier credits (Berger & Udell 1998; Huyghebaert et al. 2007; Robb & Robinson 2014). Often it is suppliers who receive important information about the start-up through recurring transactions and delivery channels. This enables them to enter into a credit relationship (Cole & Sokolyk 2018). A moderate amount of supplier credit can also be optimal from the founder's point of view (Berger & Udell 1998). For example, founders who do not want to lose control of their company choose a debt mix that focuses on short-term instruments. The effect of preferring short-term debt is reinforced if the start-up has tangible assets that could be liquidated by the bank in the event of loan default. In this case, the lower cost of capital of bank loans cannot exceed the advantage of short-term debt financing (Huyghebaert et al. 2007).

In the field of start-up financing, for a long time, there was the view that start-ups were subject to credit restrictions due to their lack of transparency of information and that access to the credit market was closed. Contrary to these assumptions, even for very young start-ups, short-term and long-term debt financing in the form of *traditional loans* provided by banks is by far the most important external source of financing (Cosh et al. 2009; Cassar 2004; Deloof & Vanacker 2018; Robb & Robinson 2014). Thus, in a study with start-ups from Australia's strongly market-oriented economy, even there about 40% of the seed capital was provided through formal credit channels (Robb & Robinson 2014). In a study by Cosh et al. (2009), banks were the external source where

start-ups sought and obtained by far the most capital. It should be noted that this also includes owner-operated bank loans as an institutional investor provides them. This is the case because at the beginning of the enterprise, technically, due to the legal form, there is no difference in insolvency between a business loan and a private bank loan (Robb & Robinson 2014). With lenders such as banks, the provision of capital goes hand in hand with the monitoring and verification of the debtor (Berger & Udell 1998). Such intermediaries cannot, however, offer the same added value as, for example, a VC fund acting as an active investor. The advantage, on the other hand, is that loans are accompanied by significantly lower capital costs (Winton & Yerramilli 2008). It can be observed that start-ups with longer relationships to the same financial institution pay a lower price for loans than those that borrow from several banks (relationship lending) (Rajan & Petersen 1994). The importance of such relationships is demonstrated by figures from a study of UK start-ups, in which 77% of all firms had a banking relationship of more than three years (Rostamkalaei & Freel 2016). High credit financing can also be seen as a quality signal for the start-up. In addition, credit financing is associated with a higher probability of survival and higher sales growth. Positive correlations between the utilization and the amount of bank financing used are particularly evident with the size of the company and the value of the tangible assets of a start-up (Cassar 2004; Rostamkalaei & Freel 2016). Banks are generally more willing to lend to optimistic founders and also demand lower interest rates from them (Dai et al. 2017). Companies with higher growth intentions are more likely to take out bank loans (Cassar 2004; Cosh et al. 2009). At the same time, those firms face higher credit pricing. This is due to the introduction of new products and innovations associated with riskier growth strategies (Rostamkalaei & Freel 2016). Because of a strong dependence on credit financing, the deterioration in credit availability due to the financial crisis has, however, massive effects on start-ups. Companies established during the crisis years are 2.4% more likely to go bankrupt within the first two years of operation (Deloof & Vanacker 2018).

#### *D. Novel forms of financing*

In addition to the traditional forms of financing described in the previous part, novel forms of financing have developed in the new millennium and especially in recent years as a result of technological progress. Through the literature search, 42 articles could be identified, which cover this topic area. These articles have been divided into 15 subcategories. Figure 3 classifies these into the start-up cycle. It has to be noted that the 3 subcategories of crowdfunding are combined.

**Figure 3:** Allocation of novel forms of financing into the life cycle of a start-up

The increasing number of subcategories already shows that the diversity of existing forms of financing has increased significantly (see Table 8). As with traditional forms of financing, there is again a subcategory *General*, whose articles can be used to describe different forms of financing. In addition, each novel form is also covered by a subcategory containing articles that treat this form as a substantive focus. Articles on novel forms of financing are thus much more specialized and focus on individual forms of financing than was the case with traditional forms of financing. Unlike before, the presentation afterward is based on a thematic grouping. For example, different forms of crowdfunding or new forms of venture capital are explained in a common section, even if some of these groups have equity or debt financing.

Table 8: Novel sources of financing

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital
					EQ Debr
<i>General</i>					
Block et al. (2018)	Theoretically	n / A	n / A	n / A	x x
<i>Accelerators and incubators</i>					
Gonzalez Uribe and Leatherbee (2018)	Quantitative; regression analysis	3,258 applicants (start-ups) for the program	Performance of the new company	Application form; selection process; web-based/poll candidates/survey participants results	x x
Aernoudt (2004)	Theoretically	n / A	n / A	n / A	x x
Albort-Morant and Oghazi (2016)	Qualitative; survey-based study	54 founders supported by an incubator	n / A	n / A	x x
van Weele et al. (2018)	Qualitative; interview-based study	13 European incubators	n / A	n / A	x x
<i>Reward-based crowdfunding</i>					
Kaminski et al. (2014)	Quantitative; mean differences	77,654 successful campaigns on Kickstarter	Venture capital investments	Investment segments and sub-segments; investment categories	x x
Mollick (2014)	Quantitative; regression analysis	48,500 campaigns on the platform Kickstarter	Success of crowdfunding project	Project features; financing ratio; supporter features; Facebook friends of the founder	x x
Petrijean (2018)	Quantitative; regression analysis	160 campaigns on the platform KKBB	Success of crowdfunding project	Amount of funds raised; geographic features; design; communication	x x
Viotto da Cruz (2018)	Quantitative; regression analysis	707 campaigns on the platform Kickstarter	Decision to release of the product	Review the campaign of the crowd	x x

Table 8: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital EQ Debt
<i>Equity and lending crowdfunding</i>					
Martínez-Climent et al. (2018)	Qualitative; literature review	20 posts	n / A	n / A	x
<i>Equity crowdfunding</i>					
Estrin et al. (2018)	Qualitative; interview-based study	62 large - and small investors	n / A	n / A	x
Hornuf and Schwiebacher (2018)	Quantitative; regression analysis	181 campaigns on 15 German platforms	# of capital committed investors during a campaign; # of successful campaigns; Amount of purchased funds	Company characteristics; Platform - and contractual characteristics	x
Lukkarinen et al. (2016)	Quantitative; regression analysis	60 campaigns on the platform Investdor Oy	# of investors; amount of purchased funds	Traditional investment criteria; crowdfunding specific variables; comprehensibility of the company concept	x
Mochkabadi and Volkmann (2018)	Qualitative; systematic literature review	113 posts	n / A	n / A	x
Parker (2014)	Theoretically	n / A	n / A	n / A	x
Walthoff-Born et al. (2018a)	Quantitative; regression analysis	277 advertised on the platform Crowdcube startups	Search for equity crowdfunding	Financial ratios; # of patent applications; professional social network; industry affiliation; other firm characteristics	x
Walthoff-Born et al. (2018b)	Quantitative; descriptive	210 ECF/no-ECF companies / 250 shareholder- or nominee structured companies	Financial performance; innovation; direct shareholder; nominee structure	Receipt of funds from equity crowdfunding	x



Table 8: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital
					EQ Debt
<i>Business angel groups and networks</i>					
Knyphausen-Aufseß and Westphal (2008)	Qualitative; Case Study concept	1 Business Angel Network	n / A	n / A	x
Lerner et al. (2018)	Qualitative; Case Study concept	13 Angel Groups	n / A	n / A	x
<i>Corporate venture capital</i>					
Chemmanur et al. (2014)	Quantitative; regression analysis	2,129 VC-backed IPOs	Number of registered patents	CVC support; # of CVC funds; shares of CVC in companies; company characteristics	x
Dushnitsky and Shapira (2010)	Quantitative; regression analysis	2,830 CVC - and IVC funds	Investment phase; syndicate size; fund performance	Investor properties	x
Kang (2019)	Quantitative; regression analysis	1,121 funded by VC company syndicates	Probability of successful exits	Relative reputation of CVC investors; geographical proximity of CVC investors and venture; syndicate experiences between CVC and IVC investors	x
Park and Steensma (2012)	Quantitative; regression analysis	508 financed by CVC and / or IVC fund companies	Success of the new company	CVC financing; specialized additional demands on assets; environmental uncertainty	x
<i>Governmental venture capital</i>					
Cumming et al. (2017)	Quantitative; regression analysis	759 new technology-based companies	Exit types	VC background; VC-size; VC-diversity	x
Guerini and Quas (2016)	Quantitative; regression analysis	183 public VC funded early stage start-ups	Financing private venture capitalist; successful exit	Financing by public VC firms	x

Table 8: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital	
					EQ	Debt
Zhang and Mayes (2018)	Quantitative; regression analysis	2,554 VC-funded portfolio companies	successful exit	Characteristics of the VC firms and portfolio companies; macro environment; availability of GVC investment	x	
<i>University funds</i>						
Croce et al. (2014)	Quantitative; regression analysis	26 University Fund	Percentage of exits of a portfolio company	Average amount invested per portfolio company; # of executives and co-investors; experience	x	
Munari et al. (2018)	Quantitative; regression analysis	128 Technology Transfer Office manager	Effectiveness of gap funding instruments	Characteristics TTO level; characteristics at university level; characteristics of environment	x	
<i>Family offices</i>						
Zellweger and Kammerlander (2015)	Theoretically	n / A	n / A	n / A	x	
<i>Patent-based investment funds</i>						
Gredel et al. (2012)	Qualitative; interview-based study	24 Participants in IP commercialization	n / A	n / A	x	x
Jarchow and Rohm (2018)	Qualitative; interview-based study	21 experts of IP commercialization	n / A	n / A	x	x
<i>Patent-based loan financing</i>						
Fischer and Ringler (2014)	Quantitative; regression analysis	1,000 security contracts	Secured patent	Patent properties		x
<i>Venture debt lending</i>						
De Rassenfosse and Fischer (2016)	Quantitative; Conjoint Analysis	55 venture debt lenders	Financing decision	Cash flow; assets; Main patents; VC funding; Warrants		x

Table 8: (continued)

Author (s) Year	Typology	Database	Dependent variable	Independent variable	Form of capital EQ Debr
Hochberg et al. (2018)	Quantitative; regression analysis	3,414 recently VC backed companies from innovations-intensive sectors	Indebtedness	Fund characteristics; patent liquidity of the market; corporate specificity	x
Týkiová (2017)	Mixed Methodology: Regression analysis; theoretical model	12,692 American VC-backed companies	Obtaining venture lending in a financing round; time to successful exit	Market, - company, - VC firm and VC fund characteristics	x
<i>Initial coin offerings</i>					
Fish (2018)	Quantitative; regression analysis	428 carried out initial coin offerings	Amount of purchased funds	Signals for technological performance	x
<i>Sustainable start-up finance</i>					
Achleitner et al. (2014)	Theoretically	n / A	n / A	n / A	x
Bergset (2018)	Quantitative; regression analysis	273 start-ups	Difficulties in access to finance; rejection of financial institutions / investors	Sustainability; innovation capacity; experience and education of the founding team; already invested funds; investment needs	x
Etapé-Dubreuil et al. (2016)	Quantitative; regression analysis	250 members of various investor clubs	Investment preferences / Drivers	Selection, monitoring factors, exit strategies	x
NMP Bocken (2015)	Qualitative; interview-based study	35 key players of VC investments	n / A	n / A	x
Petruzzelli et al. (2019)	Theoretically	n / A	n / A	n / A	x
Vismara (2018)	Quantitative; regression analysis	345 initial equity issues on Crowdcube and Seedrs	Number of investors; type of investors	Success of the campaign; sustainability orientation; intended investment amount; experience of the founding team	x

In contrast to other forms of financing, the support of *accelerators and incubators* goes far beyond financial support. *Accelerators* are temporary cohort-based programs designed to help early-stage entrepreneurs build a successful company in the first few years after start-up. Investment volumes typically range from US\$ 25,000 to US\$ 150,000 (Drover et al. 2017). In addition to financial support, such programs offer, for example, joint office space, mentoring, access to the accelerator's network and entrepreneurial training as well as education for founders with great potential (Block et al. 2018; Gonzalez-Uribe & Leatherbee 2018). In this way, accelerators enable the founders to increase their human capital in a two-part process. On the one hand, the training of the founders leads to a certification effect of these and their enterprises, on the other hand, such training increases the productivity of the founders (Gonzalez-Uribe & Leatherbee 2018). Similar to accelerators, *incubators* encourage young companies to accompany them and develop them into successful businesses. Business incubation can, therefore, be defined as a dynamic process of business development (Aernoudt 2004). However, the focus of incubators is even more on the transfer of knowledge and the help of the founders through advice and training, access to networks, but also the introduction into the market and subsequent monitoring (Aernoudt 2004; Albort-Morant & Oghazi 2016; van Weele et al. 2018). Incubators, for example, are more likely to establish links between start-ups in their network and with potential investors, than to provide capital themselves (Aernoudt 2004; van Weele et al. 2018).

Another form of start-up financing that has become increasingly important in recent years is *crowdfunding*. With a share of 7 out of 26 articles (almost 27%), the results of the literature search also illustrate this. Crowdfunding can be seen as a generic term that contains different subspecies. In the context of start-up financing, crowdfunding describes the effort of founders to obtain capital via the internet from a large group of individuals (swarm financing). In relative terms, each individual makes only a small contribution (Mollick 2014; Angerer et al. 2017). The donation-based form of crowdfunding, in which participants in a campaign provide funds without expected consideration, is not discussed below. With *reward-based crowdfunding*, on the other hand, supporters can hope for something in return. This often benefits them in the form of delivery of the supported product or service, an offer for a naming service, or an invitation to an event (Block et al. 2018; Petitjean 2018). In contrast to other species, reward-based crowdfunding generates a relatively small financing volume even on the largest platforms (Block et al. 2018). In a study with 707 campaigns on the US platform Kickstarter, the average amount generated was just under US\$ 10,000 (Viotto da Cruz 2018). In addi-

tion to the funds received, a successful campaign, especially for technology-based products, can help attract the attention of VC investors to the technology in question since the financing by the crowd is seen as a reliable assessment of it (Kaminski et al. 2018). As success factors for reward-based crowdfunding campaigns, a large social network, quality signals such as an attached video or quick updates, especially at the beginning of the campaign, the past success within the product category, the percentage of the project objective already achieved in the first week of the campaign and the number of comments have been identified. However, a requested amount that is too high and a duration that is too long reduce the success of a campaign (Mollick 2014; Petitjean 2018). *Lending-based crowdfunding* is a type of crowdfunding in which investors receive financial returns. Of all the different types of crowdfunding, this is the type with the largest total amount raised (Block et al. 2018). The required capital is mainly provided through the granting of peer-to-peer loans. The rapidly growing market for such loans is characterized by the fact that because of the direct relationship between borrower and lender via the internet, the hereby reduced transaction times - and costs result in both parties being able to expect better credit conditions than would be the case if an institution, such as a bank, were to act as an intermediary (Martínez-Climent et al. 2018). The most important type of crowdfunding for founders, however, is by far *equity crowdfunding*. Here, founders issue a public invitation to tender for the sale of a certain amount of equity or bond-like shares on a suitable internet platform (Block et al. 2018; Martínez-Climent et al. 2018). Equity crowdfunding is used primarily by innovative companies at an early stage of their development to generate capital for further growth but also to test their product and further develop their brand (Estrin et al. 2018; Mochkabadi & Volkmann 2018; Walthoff-Borm et al. 2018a). The average amount of money raised by a campaign on European platforms in 2013 was just under €250,000 (Hornuf & Schwienbacher 2018). In Europe, the British equity crowdfunding market is by far the largest and most developed market, accounting for 74% of total investments in 2015 (Walthoff-Borm et al. 2018a). Determinants of the success of a campaign could be identified in several studies with different European platforms. Consistently it was found that a smaller minimum ticket size leads to a larger aggregated sum (Hornuf & Schwienbacher 2018; Lukkarinen et al. 2016). A study with German platforms found that besides younger start-ups being generally more successful, bundling investments in a financial vehicle managed by the platform, as well as using profit-sharing loans, leads to attracting a larger number of investors (Hornuf & Schwienbacher 2018). A study of the Northern European platform Invesdor additionally identified the use of its own networks and other specific predetermined campaign characteristics as determinants of the success of a campaign (Lukkarinen et al. 2016; for more information also see Mochkabadi & Volkmann 2018).

In recent years, the very selectively distributed business angels have increasingly formed into professionalized, semi-formal *business angel groups and networks (BAG/BAN)* (Tenca et al. 2018). In the last five years, the investment sums of such groupings have almost doubled in Europe, in Canada even almost tripled (Lerner et al. 2018). Like individual business angels, business angel groups focus on young start-ups in the seed and growth phase with high growth potential. In addition to financial support, they also provide the already known further advice and help. In contrast to individual BAs, they can invest significantly higher sums in start-ups (Block et al. 2018). As a result, the investment process of business angel networks is increasingly similar to that of a venture capital fund (Tenca et al. 2018). The level of interest shown by BAGs in initial presentations and later review phases can be interpreted as an indicator of future business success so that BAGs seem to have an effective selection and review process (Chemmanur & Fulghieri 2014). In contrast to BAGs, angel networks act as financial intermediaries between business angels and companies. Its aim is to bring supply and demand together by providing the network in order to remove inefficiencies in the market for BA investments (Knyphausen-Aufse & Westphal 2008).

As already seen with business angels, the venture capital landscape is also changing. An alternative form to classic venture capital is that of *corporate venture capital (CVC)*. This form of venture capital involves subsidiaries of large corporations (Chemmanur & Fulghieri 2014; Drover et al. 2017). For strategic reasons, these companies invest through minority stakes in innovative start-ups in order to generate financial returns, synergies between the parent company and the companies involved, and to gain access to new markets and technologies (Dushnitsky & Shapira 2010; Kang 2019; Chemmanur et al. 2014). In return, they, like independent VC funds, actively contribute to the development of start-ups through support, transfer of know-how, and provision of other resources in addition to financial means (Drover et al. 2017). The CVC financing, through the connection to the underlying corporate investor, can represent a special added value, especially for start-ups that need specialized complementary assets for the commercialization and marketing of their technology (Park & Steensma 2012). The CVC market has grown strongly, especially since 2010. The number of CVC funds almost doubled between 2010 and 2014. In 2015, the CVC market, in the USA, reached almost a quarter of the size of the independent VC market with a sum of 7.7 billion US \$ (Drover et al. 2017). In Europe, the share of the VC market fluctuated between 6% and 23% between 2007 and 2015, making it very volatile. Compared to the American CVC market, it is much more likely on the European market that CVC funds will invest in earlier phases of the start-up due to institutional peculiarities (Block et al. 2018). In the USA, CVC funds invest in later rounds compared to independent VC funds. How-

ever, this difference becomes smaller when CVC fund personnel are paid based on performance. Performance-related payments of employees will lead to CVC funds no longer avoiding high-risk start-ups with high return opportunities as much as they do without performance-related payments. As a result, they tend to invest in earlier rounds and the investment process is similar to that of an independent VC fund (Dushnitsky & Shapira 2010).

In addition to companies that have entered the venture capital market, states are also endeavoring to contribute part of the start-up financing in the form of venture capital. The risk capital provided by funds whose companies are wholly owned by government entities is referred to as *governmental venture capital (GVC)* (Cumming et al. 2017; Guerini & Quas 2016). Providing capital for young, innovative start-ups can be seen as a primary goal of GVC funds. Those efforts, particularly in Europe and China, are intended to close the gap between the financing needs of such companies and the limited supply of venture capital compared with, for example, the USA (Guerini & Quas 2016; Zhang & Mayes 2018). Such investments will also be made with a view to possible positive externalities for society (Block et al. 2018). GVC funds often invest together with independent VC funds. Interestingly, this hybrid form of GVC funds and independent VC funds leads to a higher probability of a positive exit in the form of an IPO or sale than is the case with exits of companies purely supported by independent VC funds (Cumming et al. 2017). In addition, a positive influence of the hybrid form on innovations in European pharmaceutical and biotechnology start-ups was found. For the sake of completeness, it should also be noted that GVC funds may also appear as funds of funds, which, as in the case of the European Investment Fund, invest in other funds (Block et al. 2018).

*University funds* in the form of venture capital are an already older but, in the past, very limited instrument. Between 1973 and 2010, only 26 university funds were active in Europe and the USA together. However, high-ranking and important universities already have such university funds and it is not unlikely that many more will be created in the near future (Block et al. 2018; Croce et al. 2014). These are funds directly linked to the university which invest in the equity of start-ups from the university environment, such as academic spin-offs, or public research institutions. University funds pursue two objectives: On the one hand, they invest in companies whose technologies are close to the scientific field of the respective faculty; on the other hand, returns generated from the fund are used to commercialize the research of their own scientists (Croce et al. 2014; Munari et al. 2018). The prerequisites for the meaningful establishment of such a fund are a sufficiently large technology transfer office to manage resources and high quality of research to ensure the emergence of many potential companies (Munari

et al. 2018). There are significant structural differences between European and US university funds due to the different development of the VC market in both regions. American and European funds differ in the amount of invested funds, the phase in which they predominantly invest, their target group and have different exit performance on IPOs or sales (Croce et al. 2014).

Wealthy families are increasingly having their assets managed by *family offices* (Zellweger & Kammerlander 2015). In these family offices, the ownership shares of the companies in the portfolio of the family are bundled and the family holds a share of the office. Family offices are increasingly investing in younger companies with great growth potential and, with a market share of up to 5%, have thus developed into another player in the field of start-up financing. Unlike other equity providers such as VC funds or BAs, they do not play the role of active investors and make investments with a longer investment horizon (Block et al. 2018).

Some new forms of financing that take advantage of intangible assets are presented below. The most important intangible asset are patents. *Patent-based investment funds* either invest in start-ups that hold valuable patents or patentable inventions, or they buy the patents or patentable inventions of the companies in order to monetize them (Gredel et al. 2012). This is done either through royalties, the sale of patent rights, or the sale of company shares in the event of an IPO or sale of the start-up (Jarchow & Röhm 2018). In the case of the purchase of shares in companies, these funds are very similar to venture capital funds, with the only difference that their investment decisions are based solely on the patents (Gredel et al. 2012). Besides the necessary expertise to develop and commercialize technology from an invention to innovation, these funds provide financing. Patents have also been used recently for *patent-based credit financing*. They are available to the lender as collateral in the event of loan default. In the case that a patent already generates sales, e.g. through license fees, its use as collateral is clear. If this is not the case, the patent must first be evaluated in order to monetize it through a sale in the event of a loan default (Fischer & Ringler 2014).

*Venture Debt Lending (VDL)* is a form of financing which can be seen as an intersection between venture capital and classic credit financing. VDL describes the granting of loans to young start-ups mainly in the high-tech industry, where those start-ups do not have considerable fixed assets or positive cash flow (De Rassenfosse & Fischer 2016; Fischer & Ringler 2014). The market for this form was at a respectable size in 2010, with at least US \$ 3 billion (De Rassenfosse & Fischer 2016). Due to the lack of fixed assets and the often-negative cash flow, VDLs' investment decisions are based on other criteria. Start-ups that have already been financed by high-ranking and prestigious VC investors are more likely to receive a loan (Tykvová 2017). Furthermore, lenders



have a strong tendency towards start-ups offering patents as collateral (De Rassenfosse & Fischer 2016; Hochberg et al. 2018). There is a significant positive influence of the liquidity of the patent market on the indebtedness rate of companies. The better patents serve as collateral, the more willing lenders are to provide financial resources (Hochberg et al. 2018). Stock warrants play a central role in the VDLs business model as a further criterion. These allow lenders to participate in potential profits and are remunerated for the risk incurred (De Rassenfosse & Fischer 2016).

Probably the most innovative form of financing are *initial coin offerings (ICOs)*. In these cases, start-ups, whose business model is based on DLT, receive capital from a group of investors to whom they sell so-called tokens for the receipt of capital. Tokens are valued units which receive a future function within the project or serve as an investment instrument. With the former, it is often cryptocurrencies that are based on block-chain technology (e.g. Richter et al. 2015), a type of DLT. In the last two years, this market has seen rapid growth in the number of ICOs and in the amount of funds raised. For comparison, in 2018 alone, ICOs provided twice as much capital as the best-known reward-based crowdfunding platform Kickstarter in the entire period of its existence. The average amount of capital received was US \$ 21.4 million. Due to the inherent information asymmetries, the uncertain real value of the tokens, and a high fraud potential, ICO investments are considered risky. In contrast to VC funds, investors in ICOs do not value patents and human capital as a signal about the possible success of the start-up. Rather, IT publications about start-up technology and high-quality source code lead to a larger amount of capital received from an ICO (Fisch 2019).

The realization that our economy must develop in a more sustainable and resource-conserving direction has become more firmly established in recent decades with increasing awareness of global challenges such as climate change, extreme weather events, water scarcity, and the decline in biodiversity. In the area of business start-ups, this development is reflected, for example, by the emergence of so-called sustainable start-ups whose aim is to achieve ecological and/or social returns in addition to financial returns (triple bottom line) (Bocken 2015). Although, in principle, the entire financing spectrum of conventional start-ups is available to such companies, the highly relevant subject of *sustainable start-up finance* is increasingly coming to the fore in this context. This combines the topics of environmental start-up finance and social start-up finance. In the following, investors specialized in the objectives of sustainable start-ups are presented, such as social venture capital funds (SVC) (Bergset 2018). This new form of equity financing takes into account both financial and social return aspects (Achleitner et al. 2014; Bergset 2018). In addition, SVC funds demand returns below the market return but expect efficient use of the capital employed as compensation, which promises a social

return. Ensuring efficient use from a social point of view requires special and reinforced monitoring.

In addition to this new form of financing for social start-ups, actors within already known forms of financing have generally specialized in sustainable start-ups. Similar to classic VC funds, sustainable venture capital funds provide further services and assistance in addition to capital. However, the focus here is on competencies in the field of sustainability, in connection with the provision of their networks (Bocken 2015). Compared to classic VC funds, the sums of sustainable VC funds invested to date in individual companies represent only a fraction of those (Bergset 2018). Furthermore, so-called micro angels, as part of the financing form of the business angel, have also turned to the concerns of sustainable start-ups as another form of equity financing. Such micro angels have similar characteristics to classical BAs. They select their investment properties very carefully, monitor and control them and then get out of the respective start-up by an exit. The distinguishing feature is the consideration of social and ecological influences, which, in addition to economic considerations, play a major role in the selection process of possible holding companies (Etapé-Dubreuil et al. 2016). As with sustainable VC funds, micro angels were also found to be characterized by a long-term investment mentality. An exit will only be considered once a social or ecological added value has been generated by the start-up (Etapé-Dubreuil et al. 2016). Crowdfunding is another way for the founders of sustainable start-ups to raise capital for their projects (Bergset 2018; Messeni Petruzzelli et al. 2019; Vismara 2019). Sustainable campaigns differ from conventional campaigns only in the different objectives of the underlying project. While crowdfunding has gained much more attention in the literature on start-up financing in recent years, despite the large number of sustainable campaigns launched on crowdfunding platforms, little has been learned about them so far. However, some studies have found that sustainable projects are more successful than traditional projects, while others point to the exact opposite (Messeni Petruzzelli et al. 2019). On the equity crowdfunding platforms Crowdcube and Seedr, contrarily, it was found that the sustainability orientation of campaigns has no influence on their success. It could also be observed that the type of investors differs depending on the focus of the campaign. Sustainability oriented campaigns attract a significantly higher number of investors from the so-called crowd (Vismara 2019). Finally, social banks that invest in sustainability-oriented start-ups should also be mentioned as a form of debt financing within the universe of sustainable start-up finance (Bergset 2018).

#### **IV. Evaluation of the suitability of new forms of financing for start-ups**

Finally, it is necessary to evaluate the role of the new forms of financing in the spectrum of start-up financing and whether they can be attractive financing instruments. In this context, the question inevitably arises as to the extent to which new forms of financing can be regarded as complements to, or rather as substitutes for, existing sources of capital. Two theoretical principles will explain which forms of financing founders ultimately choose when financing their companies and what the capital composition looks like as a consequence. One of them is the static trade-off choice. In the decision on a form of financing, insolvency costs and agency costs are compared with tax advantages arising from debt financing (Kraus & Litzenberger 1973). In the course of this theory, there is, therefore, a balance between debt and equity financing for the type of company in question, but also for each point in time in which a company finds itself (Cassar 2004; de Bettignies 2008).

Besides, the pecking order theory is often used to explain certain financing decisions in the context of start-up financing (Myers & Majluf 1984). The theory describes a ranking in which founders consider various forms of financing. This is characterized by the fact that start-ups are highly opaque due to their novelty and, therefore, information asymmetries and agency costs occur in the relationship between the start-up and external investors. These increase the cost of capital and make external forms of financing less attractive than internal ones. Equity financing generally has higher agency costs and founders lose some control over their company in the case of external equity investors with ownership shares to be sold. They, therefore, prefer debt financing to equity financing. Banks and other institutions exercise greater control and monitoring over long-term loans, and consequently, short-term financing is preferred to long-term debt financing (Berger & Udell 1998; Cassar 2004; Cosh et al. 2009; Rostamkalaei & Freel 2016). However, this order of precedence may change in exceptional cases. This may be the case if founders have to secure loans with personal guarantees, if investors have superior information to the founder, or if they can offer added value in addition to providing financial resources. Then, following internal sources of financing, equity financing is preferred to debt financing (Berger & Udell 1998; Cosh et al. 2009; Walthoff-Borm et al. 2018a; Paul et al. 2007). It should also be noted that start-ups in different phases of their life cycle have access to different forms of financing. On the one hand, since the information asymmetries associated with the novelty of start-ups are automatically resolved with the steady growth of the company, on the other hand, investors of various forms of financing, due to their investment strategies, aim at start-ups in certain phases of their development (Berger & Udell 1998).

*Accelerators and incubators* provide little, if any, funding for early-stage start-ups as described above. Far more attractive for founders is the training and consulting that comes along with the support of accelerators and incubators, which often increases company performance. Accelerators and incubators also provide easier access to follow-on financing (Bellavitis et al. 2017; Gonzalez-Urbe & Leatherbee 2018). Interestingly, the positive effects of accelerators could only be demonstrated if training and education were also provided in addition to financial resources (Gonzalez-Urbe & Leatherbee 2018). Incubators can continue to help strengthen the network within each start-up ecosystem. However, this also shows the limitation of incubators, because they do not address the institutional causes of malfunctions, but instead, offer the members of their network solutions to mitigate the challenges posed by disadvantageous institutions (van Weele et al. 2018). Because only a small number of start-ups can participate in the programs of accelerators and incubators, the availability of and access to these two forms of financing is, however, minimal. Because of the support of accelerators and incubators, which is predominantly not based on the provision of capital, they play a special role and, therefore, cannot be classified in the course of the two theories mentioned above.

Contrary to accelerators and incubators, the possibilities to raise funds through *crowdfunding* are much higher. In 2015, the European market for lending-based crowdfunding showed an investment volume of the size of 50% compared to business angels. Lending-based crowdfunding is already the most voluminous crowdfunding form. Equity-based crowdfunding is the central type of crowdfunding for founders. Investors often make their investment decisions based on social and emotional criteria rather than financial ones, and thus information asymmetries and moral hazard problems play a smaller role (Lukkarinen et al. 2016). Moreover, the ownership shares to be sold are smaller overall than is the case with VC funds or BAs, for example, which enlarges the potential investor base (Walthoff-Borm et al. 2018a). Lending-based crowdfunding and equity-based crowdfunding can, therefore, close the financing gap between debt financing and BAs and VC funds for some start-ups (Lukkarinen et al. 2016). Nevertheless, there are quite high failure rates among start-ups listed on the respective platforms. This is the case for companies that have not carried out a successful campaign. However, even with successful campaigns, companies show a higher failure rate than companies that have received equity elsewhere (Walthoff-Borm et al. 2018a; Walthoff-Borm et al. 2018b). Concerning the pecking order theory, this adverse selection can be explained by considering equity crowdfunding as the means of choice, following internal resources and debt capacities, but still before BAs and VC funds (Walthoff-Borm et al. 2018b). Besides closing the financing gap between debt financing and BAs as well as VC funds, crowdfunding with its further development could also contribute in the future to close

the second equity financing gap found in companies already financed by equity (Walthoff-Borm et al. 2018a).

*Business angel groups and networks* are different to evaluate. Business angel groups rather take on the role of VC funds due to the allocation of capital and can thus enrich the market from investors for young companies with growth potential. Just like individual business angels, they have a positive influence on the performance of their portfolio companies (Wilson et al. 2018). Several studies show that BAG financing, regardless of the country in which it was made, increases not only the probability of survival in the first few years but also the probability of a successful exit, subsequent financing and a larger number of employees (Chemmanur & Fulghieri 2014; Lerner et al. 2018). In terms of the pecking order theory, such groups can be classified between business angels and VCs due to the described characteristics and the form of capital. Even if founders consider business angel groups, contrary to their concerns about loss of control and dilution of ownership, but due to their active support and effects on the financial life cycle, because of the specific target group only a small proportion of start-ups will ultimately be financed by BAGs. As financial intermediaries, business angel networks try to bring supply and demand together. It turns out, however, that such networks in this form as intermediaries cannot offer any added value for business angels and thus ultimately do not contribute to giving founders access to capital (Knyphausen-Aufse & Westphal 2008).

A similar picture as with BAGs emerges for *corporate venture capital* and *governmental venture capital*. There are slight differences in the rounds invested between the European and American CVC markets. In principle, however, as already described, both types of funds, just like independent VC funds, invest in young and innovative start-ups with growth potential. This has a positive impact on companies receiving financing from CVC and GVC funds. Company investors provide at least the same performance as their independent counterparts. If the employees of corporate funds are remunerated on a performance-related basis, the performance gap in favor of CVC funds becomes even greater (Dushnitsky & Shapira 2010). Additionally, companies financed by CVC funds have a higher level of innovation output, measured by patents generated, than companies of independent VC funds due to a better selection process (Chemmanur et al. 2014). The disadvantage to be mentioned is the agenda of CVC funds and their proximity to the parent company. It could be shown that within syndicates, with a balance of power in favor of CVC funds, this can lead to a focusing of the start-up on R&D activities by exerting influence. As a consequence, the probability of a successful exit is reduced (Kang 2019). Overlooking financing within the life cycle, GVC funds can make a significant contribution through their certification effect and thus secure follow-up

financing through independent VC funds (Guerini & Quas 2016). They can at least partially close the gap between the American and European VC markets, which has widened due to the financial crisis, and thus complement the European VC market (Cumming et al. 2017). In this context, it must be said that as the sole form of financing, they lose the advantages of the hybrid form and have a worse exit performance than independent VC funds (Block et al. 2018; Cumming et al. 2017). This phenomenon has been observed not only in European but with Chinese GVC funds (Zhang & Mayes 2018). As a sole form of financing, GVCs can thus be located within the pecking order behind independent VC funds. By providing at least the same performance and an effective selection process in terms of innovation output, CVC funds are more likely to substitute independent VC funds on the American market. In Europe, although, they can complement the VC market due to an earlier entry. Contrary to GVC funds, CVC funds can, therefore, still be located before independent VC funds, but with the limitation of the agenda problem. Nevertheless, these two new types remain unattainable for the vast majority of start-ups, which previously had no access to venture financing for reasons mentioned in the section on venture capital.

*University funds* should rather be regarded as a mechanism for technology transfer due to the criterion of the proximity of start-ups to the subject areas of the respective department and the low investment volume (Croce et al. 2014; Munari et al. 2018). While they can help attract more investors to their portfolio companies, with total global investments just under 3% of the traditional VC market and a relatively small number of portfolio companies invested to date, they are currently de facto of little importance to founders (Croce et al. 2014). Therefore, there is no meaningful classification for this.

The same applies to *family offices*, whose primary target group of young start-ups with growth potential is congruent with that of conventional VC funds. A described market share of 1-5% within a market, which is relevant for only a negligible number of start-ups, shows the minor importance in the overall context. Moreover, significant administrative costs associated with the management of assets by family offices suggest that, from the founder's point of view, this is not a favorable financing alternative (Zellweger & Kammerlander 2015).

Between the invention and innovation of technology, start-ups often find it very difficult to raise funding. Due to high information asymmetry and uncertainty about the technology, they find themselves in the so-called "Valley of Death", a financing gap that can lead to the failure of the enterprise. *Patent-based investment funds* are a good way for founders to raise funds at precisely this time and thus ensure the survival and growth of their own company in this critical period (Block et al. 2018; Gredel et al. 2012; Jarchow & Röhm 2018). Moreover, funds can contribute to the commercialization of

technologies with their competencies and thus become an important component of the start-up ecosystem (Jarchow & Röhm 2018). Nonetheless, it must be said that due to the investment strategy and requirements for the attractiveness of the technology, the scope of start-ups in which investments are made is limited (Gredel et al. 2012).

*Patent-based loan financing* can be an important component for the financing of innovative start-ups due to the increasing number of patents resulting from the digitalization of the knowledge economy (Block et al. 2018). Nevertheless, credit institutions that have their loans secured by patents, only include the technological quality of a patent in their valuation. They, therefore, do not exhaust the full liquidation value of a patent. This limits the use of these as collateral (Fischer & Ringler 2014). Hence there is still potential for patent-based credit financing. Classification within the pecking order theory, however, makes the two patent-based forms of financing mentioned appear to be attractive options before business angels and venture capital because apart from patent-based investment funds, which also buy company shares as a possibility, there is no equity financing.

The form of *venture debt lending*, with the already modest size of the market and the focus of respective investors on patent-based financing, can play an essential role in the overall development of patent-based financing. The same applies to the aforementioned patent-based forms, however. The above-mentioned determinants of the financing decision show that the financing stands or falls with the possession of valuable patents in addition to the VC financing previously received. As a result, venture debt lending is also limited to innovative sectors. Furthermore, the dependence of the amount of financial resources on the liquidity of the patent markets can lead to fluctuations in availability. Moreover, the probability of a successful exit is significantly lower for companies financed by venture debt lending than for companies financed purely by VC (Tykiová 2017). This makes this form of financing less attractive despite the advantage of debt financing over equity financing.

Due to the fact that *ICOs* are often executed by start-ups that are still young, ICOs cannot be seen as substitutes for conventional IPOs. In addition, ICOs only seem interesting for companies whose business model is based on the DLT. Instead, they represent another complementary form of financing in the earlier phases of a start-up. Due to the direct interaction between start-ups and investors, start-ups can raise large amounts of capital through ICOs with minimal effort and low costs, among other things, due to regulatory disclosure requirements that are still low. Considering also that if founders do not use equity tokens that resemble shares, they do not have to give up control over the company. However, the underlying technology requires a high degree

of technological understanding from the respective start-up. Thus, this form will also be accessible in the first place only for highly innovative start-ups (Fisch 2019).

The new form of financing described, as well as the already existing but transitioned forms of financing in the area of *sustainable start-up finance*, must be viewed in a differentiated manner. If social projects run a business model combining the social return with moderate financial returns, due to the conformity with the preferences of the investors, social venture capital is an attractive form of financing for these projects (Achleitner et al. 2014). However, such specialized funds are only available in very small numbers (Bergset 2018). The two transitioned forms of equity financing of micro angels and sustainable VC funds, due to their explicit consideration of the triple bottom line, can undoubtedly contribute to closing the financing gap for some sustainable start-ups. Instead, they should be seen as the first step in a development that is still imminent, in which even professional investors recognize that sustainable start-ups can be a proper investment object. They, therefore, play a pioneering role in the context of an economy that is changing towards sustainability on a global scale. The necessity of a pioneering role in consideration of crowdfunding becomes clear. Sustainable campaigns, as described, continue to be avoided by professional investors compared to commercial campaigns. At the same time, the presence of non-professional investors on crowdfunding platforms makes them an important financing instrument for sustainable start-ups, as they can find a target group that appreciates their sustainable aspirations (Vismara 2019). Thus, for sustainable start-ups, a pecking order will presumably be formed where after their own financial resources, the sustainable investor of each form of financing is always preferred to the non-sustainable investor.

## V. Conclusion

The systematic literature analysis carried out can surely help to achieve the desired holistic overview of traditional and novel forms of start-up financing, which is not yet available in this form. Furthermore, the literature analysis being conducted illustrates the importance of debt financing, contrary to the general view and despite existing information asymmetries and moral hazard problems. Not least of all, the effects of the financial crisis, with its limited lending, impressively demonstrate the sensitivity of start-ups to changes in lending decisions and thus underline the importance of loans (Robb & Robinson 2014). Supplier credits and in particular classical credit financing, even in market-based financial systems, play an important role for the majority of start-ups as a form of financing. However, it has also been shown that particularly innovative start-ups with great growth potential have had and still have limited access to credit. Even when loans are obtained, the funds are often hardly sufficient to finance business operations in



the desired form (Colombo & Grilli 2007). Such companies try to raise the missing capital through BAs or VC funds. However, these funds are often not available and even if, as shown, the rejection rates are very high (Cosh et al. 2009). Regarding the majority of new forms of financing and their target group, one thing becomes clear: precisely for innovative companies in an early phase of their existence, forms such as BAGs, the various types of venture capital funds, family offices, patent-based instruments but also ICOs, represent another possibility to raise the necessary capital. For many start-ups, however, these are currently not available due to the requirement profile and the low investment volume compared to traditional forms of financing. Such companies will continue to have to resort first to internal funds and then to external short-term and long-term debt financing, as confirmed by the pecking order theory. According to current knowledge, crowdfunding can be classified in this context after debt financing but still before other external equity financings. Increasingly, several sources are being used to obtain the required capital. Crowdfunding as a complementary form can expand the spectrum of financing forms for non-innovative start-ups. The most crucial pillar of start-up financing, therefore, remains classical credit financing. However, the emergence of new forms of financing with a focus on innovative start-ups, with great growth potential, also illustrates the change in the area of start-up financing that goes hand in hand with digitalization. Companies in innovative industries have enormous importance for the entire economy (Block et al. 2018). This also brings their financing, especially in the early years of their existence, to the fore. It can, therefore, be assumed that the importance of new forms of financing will continue to grow as digitalization and the economy as a whole develops towards an increasingly knowledge-based economy. Besides, the new forms of financing, except for patent-based credit financing, present themselves as capital market instruments. In their entirety, they represent an expansion of the capital market, especially in continental Europe, and are thus a useful complement to the banking sector prevailing there. A more market-based financial system will allow continental European economies to recover more quickly from future crises. At the same time, this ensures the provision of capital for start-ups, whose existence has extraordinary importance for the entire economy (Allard & Blavy 2011). The preceding literature analysis has shown that many different forms of financing are dealt with within the area of Entrepreneurial Finance. Future research work within this area should, however, focus even more strongly on the new forms of financing, since, due to their novelty, studies with sufficiently large data sets on the recognition of investment determinants, with the exception of crowdfunding, are largely lacking. It is also essential to understand the interdependencies resulting from the combination of different forms of financing and their impact on the performance of start-ups. Initial approaches in this direction are shown by studies of syndicates of independent VC funds with GVC and CVC funds. Due to

the still ubiquitous importance of classical credit financing, however, there are many other combinations worth investigating. The development of sustainable investors within the various forms of financing cannot be overlooked. Up to now, this has only been done for individual articles, scratching only the surface of possible research work. In the course of the general development of society, towards increased ecological awareness and a more sustainable economy, future research can make an important contribution to the expansion of knowledge.

## REFERENCES

- Achleitner, A.K., Spiess-Knafl, W. & Volk, S. (2014) The financing structure of social enterprises: conflicts and implications. *International Journal of Entrepreneurial Venturing*. 6 (1), 85-99.
- Aernoudt, R. (2004) Incubators: Tool for Entrepreneurship? *Small Business Economics*. 23, 127–135.
- Albort-Morant, G. & Oghazi, P. (2016) How useful are incubators for new entrepreneurs? *Journal of Business Research*. 69 (6), 2125–2129.
- Allard, J. & Blavy, R. (2011) Market Phoenixes and Banking Ducks Are Recoveries Faster in Market-Based Financial Systems? *IMF Working Papers*. 11 (23).
- Angerer, M., Brem, A., Kraus, S. & Peter, A. (2017) Start-up funding via equity crowdfunding in Germany: A qualitative analysis of success factors. *The Journal of Entrepreneurial Finance*, 19 (1), 1–34.
- Au, K., Chiang, F.F.T., Birtch, T.A. & Kwan, H.K. (2016) Entrepreneurial financing in new business ventures: a help-seeking behavior perspective. *International Entrepreneurship and Management Journal*. 12 (1), 199–213.
- Beck, T. & Demircug-Kunt, A. (2006) Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking and Finance*. 30 (11), 2931–2943.
- Beck, T. & Levine, R. (2002) Industry growth and capital allocation: does having a market- or bank-based system. *Journal of Financial Economics*. 64 (2), 147–180.
- Bellavitis, C., Filatotchev, I., Kamuriwo, D.S. & Vanacker, T. (2017) Entrepreneurial finance: new frontiers of research and practice. *Venture Capital*. 19 (1–2), 1–16.
- Berger, A.N. & Udell, G.F. (1998) The economics of small business finance: The roles of private equity and debt markets in the financial growth cycle. *Journal of Banking and Finance*. 22, 613–673.
- Berger, A.N. & Udell, G.F. (2006) A more complete conceptual framework for SME finance. *Journal of Banking and Finance*. 30 (11), 2945–2966.

- Bergset, L. (2018) Green start-up finance – where do particular challenges lie? *International Journal of Entrepreneurial Behaviour and Research*. 24 (2), 451–575.
- Bernstein, S., Korteweg, A. & Laws, K. (2017) Attracting Early-Stage Investors: Evidence from a Randomized Field Experiment. *Journal of Finance*. 72 (2), 509–538.
- Bertoni, F., Colombo, M.G. & Grilli, L. (2011) Venture capital financing and the growth of high-tech start-ups: Disentangling treatment from selection effects. *Research Policy*. 40 (7), 1028–1043.
- de Bettignies, J.-E. (2008) Financing the Entrepreneurial Venture. *Management Science*. 54 (1), 151–166.
- Block, J.H., Colombo, M.G., Cumming, D.J. & Vismara, S. (2018) New players in entrepreneurial finance and why they are there. *Small Business Economics*. 50 (2), 239–250.
- Bocken, N.M.P. (2015) Sustainable venture capital - Catalyst for sustainable start-up success? *Journal of Cleaner Production*. 108, 647–658.
- Bonini, S., Capizzi, V. & Zocchi, P. (2019) The performance of angel-backed companies. *Journal of Banking and Finance*. 100, 328–345.
- Bouncken, R.B., Gast, J., Kraus, S. & Bogers, M. (2015) Coopetition: a systematic review, synthesis, and future research directions. *Review of Managerial Science*. 9 (3), 577–601.
- Calabrò, A., Vecchiarini, M., Gast, J., Campopiano, G., De Massis, A. & Kraus, S. (2018) Innovation in Family Firms: A Systematic Literature Review and Guidance for Future Research. *International Journal of Management Reviews*. 00, 1–39.
- Cassar, G. (2004) The financing of business start-ups. *Journal of Business Venturing*. 19 (2), 261–283.
- Chemmanur, T.J. & Fulghieri, P. (2014) Entrepreneurial finance and innovation: An introduction and agenda for future research. *Review of Financial Studies*. 27 (1), 1–19.
- Chemmanur, T.J., Loutskina, E. & Tian, X. (2014) Corporate venture capital, value creation, and innovation. *Review of Financial Studies*. 27 (8), 2434–2473.

- Cole, R.A. & Sokolyk, T. (2018) Debt financing, survival, and growth of start-up firms. *Journal of Corporate Finance*. 50, 609–625.
- Colombo, M.G. & Grilli, L. (2007) Funding gaps? Access to bank loans by high-tech start-ups. *Small Business Economics*. 29 (1–2), 25–46.
- Conti, A., Thursby, J. & Thursby, M. (2013) Patents as signals for startup financing. *Journal of Industrial Economics*. 61 (3), 592–622.
- Cosh, A., Cumming, D.J. & Hughes, A. (2009) Outside Entrepreneurial Capital. *Economic Journal*. 119 (1), 494–533.
- Croce, A., Grilli, L. & Murtinu, S. (2014) Venture capital enters academia: An analysis of university-managed funds. *Journal of Technology Transfer*. 39 (5), 688–715.
- Cumming, D.J. (2005) Capital structure in venture finance. *Journal of Corporate Finance*. 11 (3), 550–585.
- Cumming, D.J., Grilli, L. & Murtinu, S. (2017) Governmental and independent venture capital investments in Europe: A firm-level performance analysis. *Journal of Corporate Finance*. 42, 439–459.
- Cumming, D.J. & Groh, A.P. (2018) Entrepreneurial finance: Unifying themes and future directions. *Journal of Corporate Finance*. 50, 538–555.
- Dahiya, S. & Ray, K. (2012) Staged investments in entrepreneurial financing. *Journal of Corporate Finance*. 18 (5), 1193–1216.
- Dai, N., Ivanov, V. & Cole, R.A. (2017) Entrepreneurial optimism, credit availability, and cost of financing: Evidence from U.S. small businesses. *Journal of Corporate Finance*. 44, 289–307.
- Deloof, M. & Vanacker, T. (2018) The recent financial crisis, start-up financing and survival. *Journal of Business Finance and Accounting*. 45 (7–8), 928–951.
- Denis, D.J. (2004) Entrepreneurial finance: An overview of the issues and evidence. *Journal of Corporate Finance*. 10 (2).
- Drover, W., Busenitz, L., Matusik, S., Townsend, D., et al. (2017) A Review and Road Map of Entrepreneurial Equity Financing Research: Venture Capital, Corporate

- Venture Capital, Angel Investment, Crowdfunding, and Accelerators. *Journal of Management*. 43 (6), 1820–1853.
- Dushnitsky, G. & Shapira, Z. (2010) Entrepreneurial Finance Meets Organizational Reality: Comparing Investment Practices and Performance of Corporate and Independent Venture Capitalists. *Strategic Management Journal*. 31, 990–1017.
- Elston, J.A. & Audretsch, D.B. (2011) Financing the entrepreneurial decision: An empirical approach using experimental data on risk attitudes. *Small Business Economics*. 36 (2), 209–222.
- Estapé-Dubreuil, G., Ashta, A. & Hédou, J.P. (2016) Micro-equity for sustainable development: Selection, monitoring and exit strategies of micro-angels. *Ecological Economics*. 130, 117–129.
- Estrin, S., Gozman, D. & Khavul, S. (2018) The evolution and adoption of equity crowdfunding: entrepreneur and investor entry into a new market. *Small Business Economics*. 51 (2), 425–439.
- Fisch, C. (2019) Initial Coin Offerings (ICOs) to Finance New Ventures: An Exploratory Study. *Journal of Business Venturing*. 34 (1), 1–22.
- Fischer, T. & Ringler, P. (2014) What patents are used as collateral? - An empirical analysis of patent reassignment data. *Journal of Business Venturing*. 29 (5), 633–650.
- Gonzalez-Uribe, J. & Leatherbee, M. (2018) The effects of business accelerators on venture performance: Evidence from start-Up Chile. *Review of Financial Studies*. 31 (4), 1566–1603.
- Gredel, D., Kramer, M. & Bend, B. (2012) Patent-based investment funds as innovation intermediaries for SMEs: In-depth analysis of reciprocal interactions, motives and fallacies. *Technovation*. 32 (9–10), 536–549.
- Guerini, M. & Quas, A. (2016) Governmental venture capital in Europe: Screening and certification. *Journal of Business Venturing*. 31 (2), 175–195.
- Ho, Y.P. & Wong, P.K. (2007) Financing, regulatory costs and entrepreneurial propensity. *Small Business Economics*. 28 (2–3), 187–204.

- Hochberg, Y. V., Serrano, C.J. & Ziedonis, R.H. (2018) Patent collateral, investor commitment, and the market for venture lending. *Journal of Financial Economics*. 130 (1), 74–94.
- Hornuf, L. & Schwienbacher, A. (2018) Internet-based entrepreneurial finance: lessons from Germany. *California Management Review*. 60 (2), 150–175.
- Huyghebaert, N., Van De Gucht, L. & Van Hulle, C. (2007) The choice between bank debt and trace credit in business start-ups. *Small Business Economics*. 29 (4), 435–452.
- Inderst, R. & Mueller, H.M. (2009) Early-stage financing and firm growth in new industries. *Journal of Financial Economics*. 93 (2), 276–291.
- Jarchow, S. & Röhm, A. (2018) *Patent-based investment funds: from invention to innovation*. . September 2018. The Journal of Technology Transfer.
- Jones, O. & Jayawarna, D. (2010) Resourcing new businesses: Social networks, bootstrapping and firm performance. *Venture Capital*. 12 (2), 127–152.
- Kaminski, J., Hopp, C. & Tykvová, T. (2018) New technology assessment in entrepreneurial financing – Does crowdfunding predict venture capital investments? *Technological Forecasting and Social Change*. 139 (November 2018), 287–302.
- Kang, S. (2019) The impact of corporate venture capital involvement in syndicates. *Management Decision*. 57 (1), 131–151.
- Kim, J.H. & Wagman, L. (2016) Early-stage entrepreneurial financing: A signaling perspective. *Journal of Banking and Finance*. 67, 12–22.
- Knyphausen-Aufse, D.Z. & Westphal, R. (2008) Do business angel networks deliver value to business angels? *Venture Capital*. 10 (2), 149–169.
- Kraus, A. & Litzenberger, R.H. (1973) A State-Preference Model of Optimal Financial Leverage. *The Journal of Finance*. 28 (4), 911–922.
- Lam, W. (2009) Funding gap, what funding gap? Financial bootstrapping: Supply, demand and creation of entrepreneurial finance. *International Journal of Entrepreneurial Behavior & Research*. 16 (4), 268–295.

- Lee, N., Sameen, H. & Cowling, M. (2015) Access to finance for innovative SMEs since the financial crisis. *Research Policy*. 44 (2), 370–380.
- Lerner, J., Schoar, A., Sokolinski, S. & Wilson, K. (2018) The globalization of angel investments: Evidence across countries. *Journal of Financial Economics*. 127 (1), 1–20.
- Levine, R. (2002) Bank-Based or Market-Based Financial Systems: Which Is Better? *Journal of Financial Intermediation*. 11 (4), 398–428.
- Lukkarinen, A., Teich, J.E., Wallenius, H. & Wallenius, J. (2016) Success drivers of online equity crowdfunding campaigns. *Decision Support Systems*. 87, 26–38.
- Martínez-Climent, C., Zorio-Grima, A. & Ribeiro-Soriano, D. (2018) Financial return crowdfunding: literature review and bibliometric analysis. *International Entrepreneurship and Management Journal*. 14 (3), 527–553.
- Messeni Petruzzelli, A., Natalicchio, A., Panniello, U. & Roma, P. (2019) Understanding the crowdfunding phenomenon and its implications for sustainability. *Technological Forecasting and Social Change*. 141, 138–148.
- Mitter, C. & Kraus, S. (2011) Entrepreneurial finance – issues and evidence, revisited. *International Journal of Entrepreneurship and Innovation Management*. 14 (2/3), 132.
- Mochkabadi, K. & Volkmann, C.K. (2018) Equity crowdfunding: a systematic review of the literature. *Small Business Economics*.
- Mollick, E. (2014) The dynamics of crowdfunding: An exploratory study. *Journal of Business Venturing*. 29 (1), 1–16.
- Munari, F., Sobrero, M. & Toschi, L. (2018) The university as a venture capitalist? Gap funding instruments for technology transfer. *Technological Forecasting and Social Change*. 127 (February 2018), 70–84.
- Myers, S.C. & Majluf, N.S. (1984) Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*. 13, 187–221.
- Ben Naceur, S., Marton, K. & Roulet, C. (2018) Basel III and bank-lending: Evidence



- from the United States and Europe. *Journal of Financial Stability*. 39, 1–27.
- Nambisan, S. (2017) Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship. *Entrepreneurship: Theory and Practice*. 41 (6), 1029–1055.
- Nofsinger, J.R. & Wang, W. (2011) Determinants of start-up firm external financing worldwide. *Journal of Banking and Finance*. 35 (9), 2282–2294.
- Park, H.D. & Steensma, H.K. (2012) When does corporate venture capital add value for new ventures? *Strategic Management Journal*. 33 (1), 1–22.
- Paul, S., Whittam, G. & Wyper, J. (2007) The pecking order hypothesis: does it apply to start-up firms? *Journal of Small Business and Enterprise Development*. 14 (1), 8–21.
- Petitjean, M. (2018) What explains the success of reward-based crowdfunding campaigns as they unfold? Evidence from the French crowdfunding platform KissKiss-BankBank. *Finance Research Letters*. 26 (September 2018), 9–14.
- Rajan, R.G. & Petersen, M.A. (1994) The Benefits of Lending Relationships: Evidence from Small Business Data. *The Journal of Finance*. 49 (1), 3–37.
- De Rassenfosse, G. de & Fischer, T. (2016) Venture debt financing: determinants of the lending decision. *Strategic Entrepreneurship Journal*. 10, 235–256.
- Ratzinger, D., Amess, K., Greenman, A. & Mosey, S. (2018) The impact of digital start-up founders' higher education on reaching equity investment milestones. *Journal of Technology Transfer*. 43 (3), 760–778.
- Richter, C., Kraus, S. & Bouncken, R. B. (2015) Virtual currencies like Bitcoin as a paradigm shift in the field of transactions. *International Business & Economics Research Journal*, 14 (4), 575–586.
- Robb, A.M. & Robinson, D.T. (2014) The capital structure decisions of new firms. *Review of Financial Studies*. 27 (1), 153–179.
- Rostamkalaei, A. & Freel, M. (2016) The cost of growth: small firms and the pricing of bank loans. *Small Business Economics*. 46 (2), 255–272.

- Shane, S. & Cable, D. (2002) Network Ties, Reputation, and the Financing of New Ventures. *Management Science*. 48 (3), 364–381.
- Stiglitz, J.E. & Weiss, A. (1981) Credit Rationing in Markets with Imperfect Information. *The American Economic Review*. 71 (3), 393–410.
- Tenca, F., Croce, A. & Ughetto, E. (2018) Business angels research in entrepreneurial finance: A literature review and a research agenda. *Journal of Economic Surveys*. 00 (0), 1–30.
- Tranfield, D., Denyer, D. & Smart, P. (2003) Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*. 14 (3), 207–222.
- Tykvová, T. (2017) When and Why Do Venture-Capital-Backed Companies Obtain Venture Lending? *Journal of Financial and Quantitative Analysis*. 52 (3), 1049–1080.
- Viotto da Cruz, J. (2018) Beyond financing: crowdfunding as an informational mechanism. *Journal of Business Venturing*. 33 (3), 371–393.
- Vismara, S. (2018) Sustainability in equity crowdfunding. *Technological Forecasting and Social Change*. 1–9.
- Walthoff-Borm, X., Schwienbacher, A. & Vanacker, T. (2018) Equity crowdfunding: First resort or last resort? *Journal of Business Venturing*. 33 (4), 513–533.
- Walthoff-Borm, X., Vanacker, T. & Collewaert, V. (2018) Equity crowdfunding, shareholder structures, and firm performance. *Corporate Governance: An International Review*. 26 (5), 314–330.
- van Weele, M., van Rijnsoever, F.J., Eveleens, C.P., Steinz, H., et al. (2018) Start-EU-up! Lessons from international incubation practices to address the challenges faced by Western European start-ups. *Journal of Technology Transfer*. 43 (5), 1161–1189.
- Wilson, N., Wright, M. & Kacer, M. (2018) The equity gap and knowledge-based firms. *Journal of Corporate Finance*. 50, 626–649.

- Winton, A. & Yerramilli, V. (2008) Entrepreneurial finance: Banks versus venture capital. *Journal of Financial Economics*. 88 (1), 51–79.
- Wu, J., Si, S. & Wu, X. (2016) Entrepreneurial finance and innovation: Informal debt as an empirical case. *Strategic Entrepreneurship Journal*. 10, 257–273.
- Zellweger, T.M. & Kammerlander, N. (2015) Family, wealth, and governance: an agency account. *Entrepreneurship Theory and Practice*. 39 (6), 1281–1303.
- Zhang, Y. & Mayes, D.G. (2018) The performance of governmental venture capital firms: A life cycle perspective and evidence from China. *Pacific Basin Finance Journal*. 48 (September 2017), 162–185.

## ANNEX I. Tables

**Table 9: Distribution of articles on different journals**

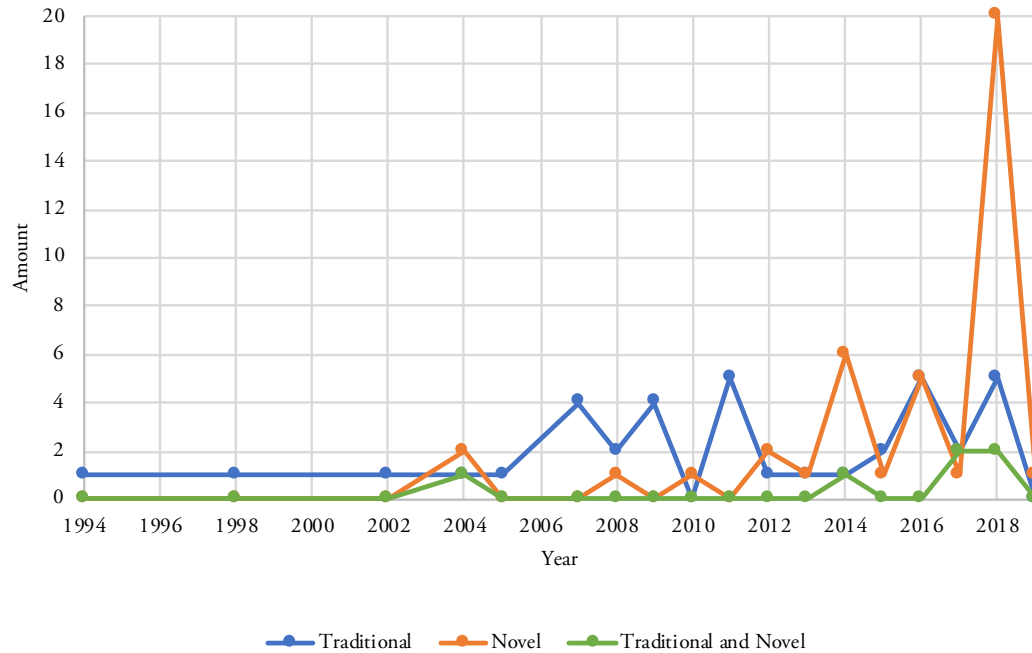
Journal	Number of items
Small Business Economics	9
Journal of Corporate Finance	9
Journal of Business Venturing	7
Journal of Financial Economics	4
Journal of Banking and Finance	4
The Review of Financial Studies	4
Journal of Technology Transfer	4
Technological Forecasting and Social Change	4
Venture Capital	3
International Entrepreneurship and Management Journal	2
Journal of Business Research	2
Research Policy	2
Strategic Entrepreneurship Journal	2
Journal of Finance	2
International Journal of Entrepreneurial Behavior and Research	2
Management Science	2
Strategic Management Journal	2
California Management Review	1
Decision Support Systems	1
Economics Letters	1
Entrepreneurship Theory and Practice	1
International Journal of Entrepreneurial Venturing	1
International Journal of Entrepreneurship and Innovation Management	1
International Small Business Journal	1
Journal of Business Finance and Accounting	1
Journal of Economic Surveys	1
Journal of Industrial Economics	1
Journal of Management	1
Technovation	1
Economic Journal	1
Journal of Small Business and Enterprise Development	1
Finance Research Letters	1
Corporate Governance: An International Review	1
Journal of Cleaner Production	1
Ecological Economics	1
Management Decision	1
Pacific-Basin Finance Journal	1
Journal of Financial and Quantitative Finance	1

**Table 10: Classical and novel sources of financing**

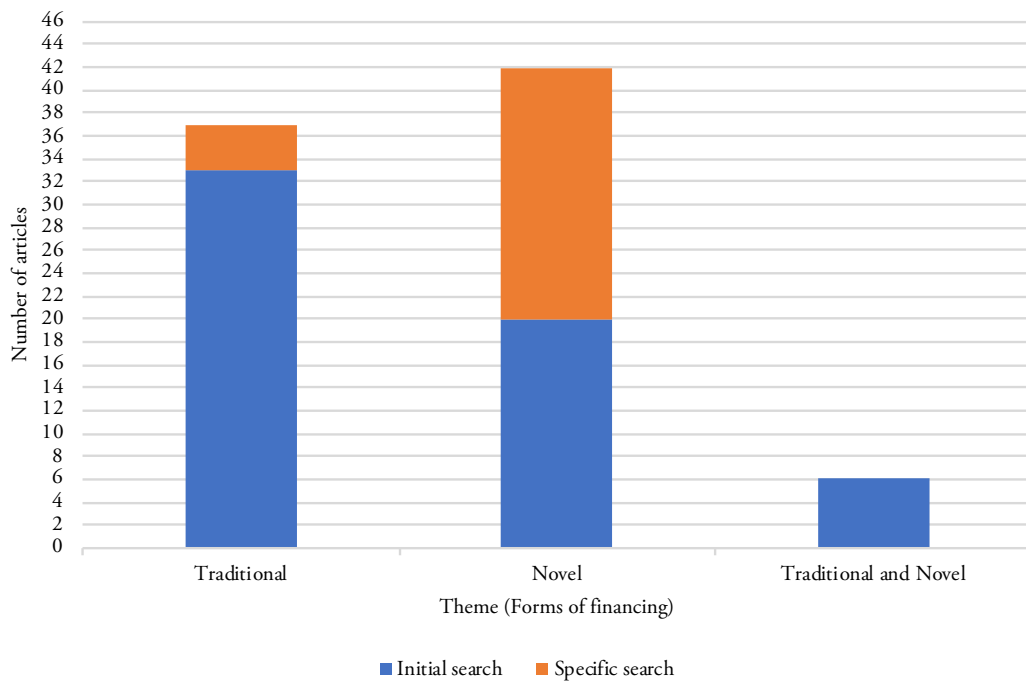
Author (s) Year	Typology	Database	Dependent variable	Independent variable	EQ	Form of capital Debt
<i>General</i>						
Bellavitis et al. (2017)	Theoretically	n / A	n / A	n / A	x	x
Chemmanur and Fulghieri (2014)	Theoretically	n / A	n / A	n / A	x	x
Cumming and Groh (2018)	Qualitative; literature review	25 posts	n / A	n / A	x	x
<i>Equity financing</i>						
Denis (2004)	Qualitative; literature review	32 posts	n / A	n / A	x	
Drover et al. (2017)	Qualitative; literature review	418 posts	n / A	n / A	x	
<i>Business angel and business angel networks</i>						
Tenca et al. (2018)	Qualitative; literature review	139 posts	n / A	n / A	x	

(Four of the six articles only take up a few of the many traditional and novel forms of financing. The other two articles refer either exclusively to different equity financing or to the business angel issue. Because of this, these six articles in this category will be used in the other two categories to describe individual forms of financing)

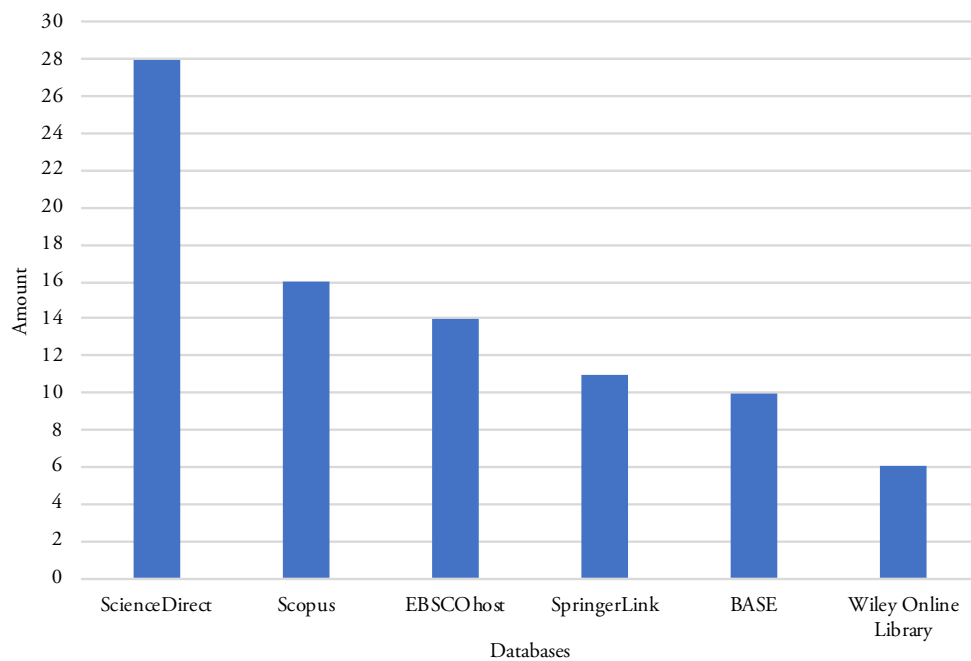
## ANNEX II. Illustrations

**Figure 4:** Aggregate publications per form of financing (N=85)

**Figure 5:** Results of initial and specific research



**Figure 6:** Distribution of articles on databases



**Figure 7:** Distribution of journals according to the ABS-Ranking (N=85)